Energy Fuels Resources (USA) Inc.
225 Union Blvd. Suite 600
Lakewood, CO, US, 80228
303 974 2140
www.energyfuels.com

February 6, 2024

Via Express Delivery and Electronic Mail

Mr. Daniel Czecholinski
Director, Air Quality Division
Arizona Department of Environmental Quality
Air Quality Division
1110 West Washington
Phoenix, AZ 85007

Re: Renewal of Energy Fuels Class II Permit 75725, Arizona 1 Mine

Dear Mr. Czecholinski:

Energy Fuels Resources (USA) Inc. (EFRI) operates the Arizona 1 Mine located approximately 35 miles south of Fredonia, Arizona. Class II air quality permit #75725 is scheduled to expire on August 11, 2024. Permit #75725 was issued August 13, 2019, and is a renewal to Permit #63895. EFRI is submitting the attached permit application to renew Permit #75725. Attachments to this letter complete the necessary information required as part of the permit renewal application and include:

A Permit Application Form, Equipment List, and Emission Source Form
B Emission Calculations

Operation of the mine will remain consistent with the current permit. Please refer to the original Class II permit application submitted in January 2008 and the supplemental dispersion modeling report submitted in December 2008 for detailed project description, applicable requirements, facility flow diagram, and dispersion modeling analyses.

Potential to Emit (PTE) emissions have not changed from the values included in Permit #75725 but have been provided in Attachment B for reference. The electronic emission calculations file is also attached with this application package.

Please feel free to contact me at 303-389-4132 or sbakken@energyfuels.com with any questions or concerns.

Sincerely,

Energy Fuels Resources (USA) Inc.
Scott Bakken
Vice President, Regulatory Affairs

Attachments

Cc: Nick Martin, Kathy Weinel EFRI

ATTACHMENT A

RENEWAL PERMIT APPLICATION

SECTION 3.1

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Air Quality Division

1110 West Washington • Phoenix, AZ 85007 • Phone: (602) 771-2338

STANDARD CLASS II PERMIT APPLICATION FORM

(As required by A.R.S. § 49-426, and Chapter 2, Article 3, Arizona Administrative Code)

1. Permit to be issued to (Business license name of organization that is to receive permit):
   Energy Fuels Resources (USA) Inc.

2. Mailing Address: 225 Union Blvd. Suite 600
   City: Lakewood State: Colorado ZIP: 80228

3. Name (or names) of Responsible Official: Scott Bakken
   Phone: 303-389-4132 Fax: Email: sbakken@energyfuels.com

4. Facility Manager/Contact Person and Title: Race Fisher - CP Asset Manager
   Phone: 435-686-9949 Fax: Email: rfisher@energyfuels.com

5. Facility Name: Arizona 1 Mine
   Facility Location/Address (Current/Proposed): 35 miles south of Fredonia
   City: South of Fredonia County: Mohave ZIP: 86022
   Indian Reservation (if applicable, which one): N/A
   Latitude/Longitude, Elevation: 36.507 deg N / 112.806 ded W, 1690 m (5546 ft)

6. General Nature of Business: Underground Uranium Mine

7. Type of Organization:
   ☒ Corporation ☐ Individual Owner ☐ Partnership ☐ Government Entity ☐ LLC
   Other

8. Permit Application Basis: ☐ New Source ☐ Revision ☒ Renewal of Existing Permit
   For renewal or modification, include existing permit number (and exp. date): 75725, expires 8-11-2024
   Date of Commencement of Construction or Modification: N/A
   Primary Standard Industrial Classification Code: 1094

9. I certify that I have knowledge of the facts herein set forth, that the same are true, accurate and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by ADEQ as public record. I also attest that I am in compliance with the applicable requirements of the Permit and will continue to comply with such requirements and any future requirements that become effective during the life of the Permit. I will present a certification of compliance to ADEQ no less than annually and more frequently if specified by ADEQ. I further state that

I will assume responsibility for the construction, modification, or operation of the source in accordance with Arizona Administrative Code, Title 18, Chapter 2 and any permit issued thereof.

Signature of Responsible Official: _____

Printed Name of Signer/Official Title: Scott A. Bakken - VP, Regulatory Affairs

Date: 2/6/2024 Telephone Number: 303-389-4132

Section 3.5 - Equipment List

Type of Equipment	Maximum Rated Capacity [1]	Make	Model	Serial Number	Date of Manufacture	Equipment ID Number
Emergency Generator	400 kW	Cummins	680FDC5038AAW	41650	May 1974	Cummins Part No.214365
Gasoline Storage Tank	N/A	N/A	N/A	N/A	N/A	F2777

[1} For generator sets, enter the maximum rated capacity of the engine rather than the maximum rated capacity of the generator.

All relevant equipment utilized at the facility should be included in the equipment list. Please complete all fields.
The date of manufacture must be included in order to determine applicability of regulations.
Indicate the units (tons/hour, horsepower, etc.) when recording the maximum rated capacity.
Make additional copies of this form if necessary.
***Submit photographs of the faceplates for all engines listed above.**
***If an engine is certified, please also include a copy of the engine certification with the application.**
***For any newly added equipment, include a copy of the specification sheet.**
***These documents will be used to verify equipment information and determine applicable regulations.**

SECTION 3.6 - EMISSION SOURCE FORM (Page 1)

					USE THIS SECTION FOR MODIFICATIONS ONLY		
Emission Point		Regulated Air Pollutant Name	PTE		PTE AFTER MODIFICATION		CHANGE IN PTE
Number	Name		lbs/hr	tons/yr	lbs/hr	tons/yr	tons/yr
1	Emergency Generator	CO	3.58	0.21			
		NOx	16.6	1.00			
		$PM/PM_{10}/PM_{2.5}$	1.18	0.07			
		VOC	1.35	0.08			
		SO_2	1.10	0.07			
		HAPs	5.17E-3	3.10E-4			
2	Gasoline Storage Tank	VOC	0.07	0.30			
		HAPs	6.09E-3	0.03			
3	Diesel Storage Tank	VOC	6.04E-4	2.65E-3			
		HAPs	6.46E-5	2.83E-4			
4	Vents	$PM/PM_{10}/PM_{2.5}$	0.31	1.37			
		HAPs	1.28E-3	5.62E-3			
5	Front End Loaders	PM	0.20	0.88			
		PM_{10}	0.10	0.42			
		$PM_{2.5}$	0.01	0.06			

****Submit emission calculations spreadsheet with your application****

SECTION 3.6 - EMISSION SOURCE FORM (Page 2)

					USE THIS SECTION FOR MODIFICATIONS ONLY		
Emission Point		Regulated Air Pollutant Name	PTE		PTE AFTER MODIFICATION		CHANGE IN PTE
Number	Name		lbs/hr	tons/yr	lbs/hr	tons/yr	tons/yr
	Front End Loaders (cont)	HAPs	3.89E-4	1.71E-3			
6	Vehicle Traffic	PM	4.88	21.40			
		PM_{10}	1.29	5.67			
		$PM_{2.5}$	0.13	0.57			
7	Storage Piles	PM	0.07	0.31			
		PM_{10}	0.04	0.16			
		$PM_{2.5}$	0.01	0.02			
		HAPs	9.35E-5	4.02E-4			

****Submit emission calculations spreadsheet with your application****

SECTION 5.0 -APPLICATION ADMINISTRATIVE COMPLETENESS CHECKLIST

	REQUIREMENT	MEETS REQUIREMENTS			COMMENT
		YES	NO	N/A	
1	Has the standard application form been completed?	X			
2	Has the responsible official signed the standard application form?	X			
3	Has a process description been provided?	X			
4	Are the facility's emissions documented with all appropriate supporting information?	X			
5	Is the facility subject to Minor NSR requirements? If the answer is "YES" , answer 6a, 6b and 6c as applicable. If the answer is "NO", skip to 7.			X	
6.a	If the facility chooses to implement RACT, is the RACT determination included for the affected pollutants for all affected emission units?				
6.b	If the facility chooses to demonstrate compliance with NAAQS by screen modeling, is the modeling analysis included?				
6.c	If refined modeling has been conducted, is a comprehensive modeling report along with all modeling files included?				
7	Does the application include an equipment list with the type, name, make, model, serial number, maximum rated capacity, and date of manufacture?	X			
8	Does the application include an identification and description of Pollution Controls? (if applicable)	X			
9	For any application component claimed as confidential, are the requirements of AR.S. 49-432 and A.A.C. R18-2-305 addressed?			X	
10	For any current non-compliance issue, is a compliance schedule attached?			X	
11	For minor permit revision that will make a modification upon submittal of application, has a suggested draft permit been attached?			X	

ATTACHMENT B

EMISSION CALCULATIONS

TABLE B-1
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
FACILITY-WIDE POTENTIAL ANNUAL EMISSIONS (TONS PER YEAR)

EMISSIONS	Generator	Vent Holes	Material Handling Sources	Storage Pile Fugitive Sources	On-Site Road Fugitive Sources	Storage Tank Emissions	Total (tons/yr)	Off-Site Road Fugitive Sources (tons/yr)
Criteria Pollutants								
CO	0.21	--	--	--	--	--	**0.2**	--
NOx	1.0	--	--	--	--	--	**1.0**	--
$PM_{2.5}$	0.07	1.37	0.06	0.02	0.57	--	**2.1**	23.54
PM_{10}	0.07	1.37	0.42	0.16	5.67	--	**7.7**	235.4
PM	0.07	1.37	0.88	0.31	21.40	--	**24.0**	400.2
VOC	0.08	--	--	--	--	0.297	**0.38**	--
SO_2	0.07	--	--	--	--	--	**0.07**	--
Lead	--	--	5.41E-06	2.04E-06	--	--	**7.45E-06**	--
Greenhouse Gases								
CO_2e	76.3	--	--	--	--	--	**76.3**	

'--' Emissions of compound are either not present or were not reported in the literature reviewed.

TABLE B-2
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
FACILITY-WIDE POTENTIAL SHORT TERM EMISSIONS (POUNDS PER HOUR)

EMISSIONS	Generators	Vent Holes	Material Handling Sources	Storage Pile Fugitive Sources	On-Site Road Fugitive Sources	Storage Tank Emissions	Totals	Off-Site Road Fugitive Sources (tons/yr)
Criteria Pollutants								
CO	3.58	--	--	--	--	--	**3.58**	--
NOx	16.63	--	--	--	--	--	**16.63**	--
$PM_{2.5}$	1.18	0.31	0.01	0.01	0.13	--	**1.64**	5.4
PM_{10}	1.18	0.31	0.10	0.04	1.29	--	**2.92**	53.7
PM	1.18	0.31	0.20	0.07	4.88	--	**6.65**	86.4
VOC	1.35	--	--	--	--	0.07	**1.42**	--
SO_2	1.10	--	--	--	--	--	**1.10**	--
Lead	--	--	1.24E-06	6.99E-07	--	--	**1.94E-06**	--

'--' Emissions of compound are either not present or were not reported in the literature reviewed.
NA - not available

TABLE B-3
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
FACILITY-WIDE POTENTIAL ANNUAL HAZARDOUS AIR POLLUTANT EMISSIONS
(TONS PER YEAR)

EMISSIONS	Generators	Material Handling Sources	Storage Pile Fugitive Sources	Storage Tank Emissions	Vent Holes	Total Controlled Emissions
Naphthalene	6.94E-06	--	--	--	--	**6.94E-06**
Acetaldehyde	6.28E-05	--	--	--	--	**6.28E-05**
Acrolein	7.57E-06	--	--	--	--	**7.57E-06**
Benzene	7.64E-05	--	--	3.31E-03	--	**3.39E-03**
1,3-Butadiene	3.20E-06	--	--	--	--	**3.20E-06**
Ethyl benzene	--	--	--	8.05E-04	--	**8.05E-04**
Formaldehyde	9.66E-05	--	--	--	--	**9.66E-05**
Hexane	--	--	--	5.43E-03	--	**5.43E-03**
Styrene	--	--	--	2.95E-05	--	**2.95E-05**
Toluene	3.35E-05	--	--	9.28E-03	--	**9.32E-03**
2,2,4-Trimethylpentane	--	--	--	4.33E-03	--	**4.33E-03**
Xylenes	2.33E-05	--	--	3.75E-03	--	**3.77E-03**
Arsenic	--	1.92E-05	7.20E-06	--	6.31E-05	**8.95E-05**
Lead	--	5.41E-06	2.04E-06	--	1.78E-05	**2.53E-05**
Nickel	--	6.25E-06	2.35E-06	--	2.06E-05	**2.92E-05**
Selenium	--	1.25E-06	4.70E-07	--	4.11E-06	**5.83E-06**
Uranium	--	1.67E-03	3.87E-04	--	5.49E-03	**7.54E-03**
Vanadium	--	7.91E-06	2.97E-06	--	2.61E-05	**3.69E-05**
Total HAPs	**3.10E-04**	**1.71E-03**	**4.02E-04**	**2.69E-02**	**5.62E-03**	**3.50E-02**

TABLE B-4
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
PILES AND PRODUCTION RATES[1]

Material Produced	Maximum Amount Produced Annually (tons/year)	Storage Pile Name	Pile ID	Total Pile Volume (ft^3)	Pile Base Area (acres)	Pile Length (L) (ft)	Pile Width (W) or Radius (R) (ft)	Pile Height (H) (ft)	Shape[3]	Exposed Surface Area (ft^2)
Ore	36,500	High Grade Ore Stockpile	HGOS	38,720	0.33	70	68	8	Cone	14,600
	36,500	Medium Grade Ore Stockpile	MGOS	38,720	0.33	70	68	8	Cone	14,600
	36,500	Low Grade Ore Stockpile	LGOS	38,720	0.33	70	68	8	Cone	14,600
Development Rock	54,750	Development Rock Area	WDA	263,716	1.21	230	230	5	Box	57,300
Topsoil[2]	8,073	Topsoil Stockpile	TS	161,459	0.46	82.02	246	8	Box	25,400

1 Pile dimensions listed (radius and length) are approximate, and are based on estimated pile heights and base areas given by the facility.
2 The amount of topsoil listed in the table is the amount produced over the lifetime of the mine, which is currently in existance.
3 If the shape listed is a box, the surface area is calculated as the sum of the areas of the five exposed faces of the pile (LW + 2LH + 2WH).
If the shape listed is a cone, the surface area is calculated as the exposed area of the cone ($\pi * R * \sqrt{(R^2 + H^2)}$).

TABLE B-5
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
GENERATOR EMISSIONS - CRITERIA POLLUTANTS

Explanation: The Arizona 1 Mine receives its prime power from overhead electrical lines. One generator is used as a backup in the event of power outage or generator maintenance. The emission estimates are based on one 400-kW backup generator using No. 2 fuel oil. The calculations are based on specifications from the generator manufacturer and AP-42 emission factors as noted.

Emission Equations:

Hourly Emissions (lbs/hr) = PR * (1.341 hp/kW) * E (lb/hp-hr)

24-Hour emissions (lb/hr) = Hourly Emissions (lbs/hr) * D/24hours

Annual emissions (tons/yr) = Hourly Emissions (lbs/hr) * OH * (ton/2000 lbs)

Where:
PR = generator power rating (kW)
E = emission factor
OH = annual operating hours (hours/year)
D = daily operating hours (hours/day)

Data:

PR (400 kW) =	400	kW
OH (400 kW) =	120	hours/year
D (400 kW) =	12	hours/day

Generator Emissions Estimate

Generator Size	Pollutant	Emission Factor per Unit	Units	Emission Factor Source	Hourly Emissions[3] (lb/hr)	24-Hour Emissions[3] (lb/hr)	Annual Emissions (tons/yr)
Standby Generator (400-kW) [1]	CO	6.68E-03	lb/hp-hr	AP-42 (10/96) Table 3.3-1	3.58	NA	0.21
	NO_X	0.031	lb/hp-hr	AP-42 (10/96) Table 3.3-1	16.63	NA	1.00
	$PM_{10}/PM_{2.5}$	2.20E-03	lb/hp-hr	AP-42 (10/96) Table 3.3-1	1.18	0.59	0.07
	PM	2.20E-03	lb/hp-hr	AP-42 (10/96) Table 3.3-1	1.18	0.59	0.07
	VOC	2.51E-03	lb/hp-hr	AP-42 (10/96) Table 3.3-1 [2]	1.35	NA	0.08
	SO_2	2.05E-03	lb/hp-hr	AP-42 (10/96) Table 3.3-1	1.10	NA	0.07

[1] All emission factors are all taken from AP-42, Table 3.3-1, Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines. (Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines).

[2] The VOC emission factor is equal to 100% of the AP-42 Total Organic Compounds emission factor.

[3] All short-term emissions were calculated based on hourly emission averages, except for PM_{10}, which was calculated based on a 24-hour average.

TABLE B-6
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
FRONT-END LOADER MATERIAL HANDLING EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **FRONT-END LOADER - LOADING AND UNLOADING**
Pollutants: **PM, PM_{10}, $PM_{2.5}$**

Emission Factor From: **AP-42, Section 13.2.4**
"Aggregate Handling and Storage Piles"
Emission Factor Rating: **A**
Explanation: A front-end loader is used to move ore and development rock from the mine shaft into haul trucks or the stockpile areas.

Emission Equations: $E = k*0.0032 *[((U/5)^{1.3})/((M/2)^{1.4})]$

Where:
E = emission factor (lbs/ton)
k = Aerodynamic Particle Size Multiplier (unitless)
U = mean wind speed (mph)
M = material moisture content (%)

Data:

k_{PM10} =	0.35		[Areodynamic Particle Size Multiplier for pm < 10 μm (AP-42 13.2.4)]
k_{PM} =	0.74		[Areodynamic Particle Size Multiplier for pm < 30 μm (AP-42 13.2.4)]
$k_{PM2.5}$ =	0.053		[Areodynamic Particle Size Multiplier for pm < 2.5 μm (AP-42 13.2.4)]
U =	6.32	mph	[2006 mean wind speed from Grand Canyon NP meteorological station]
M_{ore} =	5.4	%	[mean moisture content for lump ore from iron and steel production (AP-42, Table 13.2.4-1)]
$M_{dev\ rock}$ =	0.4	%	[mean moisture content for tailings from taconite mining and processing (AP-42, Table 13.2.4-1)]

E_{ore} =	**0.0003781**	**lbs PM_{10}/ton ore**
E_{DR} =	**0.0144560**	**lbs PM_{10}/ton rock**
E_{ore} =	**0.0007994**	**lbs PM/ton ore**
E_{DR} =	**0.0305640**	**lbs PM/ton rock**
E_{ore} =	**0.0000573**	**lbs $PM_{2.5}$/ton ore**
E_{DR} =	**0.0021890**	**lbs $PM_{2.5}$/ton rock**

Annual PM_{10} emissions (tons/yr) = E * P * (ton/2000 lbs)
Short-term PM_{10} emissions (lbs/hr) = E * P / H

Where:
P = Annual production rate (tpy)
H = Working hours per year (hrs/yr)
= 8760 hours/year [assumes mine will be operational 365 days/year, 24 hours/day]

Material Handling	P (tpy)	H (hrs/yr)	PM_{10} Emissions (lbs/hr)	PM_{10} Emissions (tons/yr)	PM Emissions (lbs/hr)	PM Emissions (tons/yr)	$PM_{2.5}$ Emissions (lbs/hr)	$PM_{2.5}$ Emissions (tons/yr)
Ore Unloading	109,500	8,760	0.0047	0.021	0.0100	0.044	0.0007	0.003
Dev Rock Unloading	54,750	8,760	0.0903	0.396	0.1910	0.837	0.0137	0.060
Total Emissions			**0.10**	**0.42**	**0.20**	**0.88**	**0.01**	**0.06**

TABLE B-7
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
STOCKPILE EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **Wind Erosion of Stockpiles (Topsoil, development Rock, and Ore)**
Pollutants: **PM, PM_{10}, $PM_{2.5}$**

Emission Factor From: **AP-42, Section 13.2.5; Industrial Wind Erosion**
Explanation: The topsoil pile has been seeded to mitigate fugitive dust.
Ore and development rock range from 1 to 6 inches in size.

Emission Equations:

$$E_{uc} = P * A * k * N \quad \text{grams/year}$$

$$P = 58(u'-u_t)^2 + 25(u'-u_t)$$

$$u' = 0.1 * u10 * (u_s/u_r)$$

$$u10 = u*(\ln(10/0.005)/ \ln(h/0.005))$$

$$E_c = E_{uc} * (100-C)/100$$

Where:

E_{uc} = uncontrolled particle emissions (grams/year)
P = pile erosion potential (grams/m^2-disturbance)
A = pile surface area (m^2)
k = Aerodynamic Particle Size Multiplier (dimensionless)
N = number of pile disturbances in one year (disturbances/year)
u' = friction velocity (m/s)
u_t = threshold velocity (m/s) found in AP-42, Table 13.2.5-2
u10 = corrected fastest mile wind speed (m/s)
u_s/u_r = ratio of surface wind speed to approach wind speed (unitless)
u = fastest wind speed for the periods between disturbances (m/s)
h = anemometer height (m)
E_c = controlled particle emissions (grams/year)
C = control efficiency (%)

Data:

k_{PM10} =	0.5	unitless	[Areodynamic Particle Size Multiplier for particles < 10 µm (AP-42 13.2.5)]
k_{PM} =	1	unitless	[Areodynamic Particle Size Multiplier for particles < 30 µm (AP-42 13.2.5)]
$k_{PM2.5}$ =	0.075	unitless	[Areodynamic Particle Size Multiplier for particles < 2.5 µm (AP-42 13.2.5)]
N =	1	disturbances/year	[assumed total surface area of the piles are disturbed once per year on average]
u_t =	1.33	m/s	[assumed threshold friction velocity for scoria, AP-4 13.2.5]
	1.02	m/s for top soil	[assumed threshold friction velocity for overburden, AP-4 13.2.5]
u_s/u_r =	0.9		[assumed maximum value, taken from AP-42, Section 13.2.5; maximum value will produce maximum emissions]
u =	46.0	miles per hour	[Fastest Mile for Flagstaff, AZ, measured May 1975, from Climate Data Summary]
h =	10	m	[assumed anemometer height for Flagstaff, AZ]
C =	90	%	[assumed control efficiency for seeding topsoil piles]

Annual PM Emissions:

Pile	Pile Volume (cubic ft.)	Annual Disturbed Area (sq.ft.)	Uncontrolled PM_{10} Emissions		Controlled PM_{10} Emissions		Controlled PM Emissions		Controlled $PM_{2.5}$ Emissions	
			(tons/yr)	(lb/hr)	(tons/yr)	(lb/hr)	(tons/yr)	(lb/hr)	(tons/yr)	(lb/hr)
High Grade Ore Stockpile	39,000	14,600	0.021	0.005	0.021	0.005	0.043	0.010	0.003	0.0007
Medium Grade Ore Stockpile	39,000	14,600	0.021	0.005	0.021	0.005	0.043	0.010	0.003	0.0007
Low Grade Ore Stockpile	39,000	14,600	0.021	0.005	0.021	0.005	0.043	0.010	0.003	0.0007
Development Rock Area	264,000	57,300	0.084	0.019	0.084	0.019	0.169	0.038	0.013	0.0029
Topsoil Stockpile	161,000	25,400	0.079	0.018	0.008	0.002	0.016	0.004	0.001	0.0003
		Total Pile Emissions	**0.228**	**0.052**	**0.157**	**0.036**	**0.313**	**0.071**	**0.023**	**0.005**

Note: It was assumed the entire surface area of a pile will be available for disturbance at any given time.

TABLE B-8
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
FUGITIVE UNPAVED ROAD EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **FUGITIVE DUST EMISSIONS FROM VEHICLE TRAFFIC**
Pollutants: **PM, PM_{10}, $PM_{2.5}$**

Emission Factor Reference: **AP-42, Section 13.2.2**
"Unpaved Roads"

Emission Factor Rating: **B**

Explanation:

PM emissions for on-site vehicle traffic are calculated by using the emission factor equation for unpaved roads in AP-42, Section 13.2.2. Emissions are calculated by first calculating an emission factor for each vehicle type, which is then multiplied by the calculated vehicle miles traveled (VMT) for each vehicle. To calculate VMT, an examination of the on-site roads is necessary. All roads within the facility boundary are unpaved. Nonroad vehicles, such as front-end loaders, will travel only on-site in the portal area. In most cases, the VMT is calculated by taking the frequency of use and multiplying by the quantity of the amount of material hauled divided by the capacity of the vehicle. The product is then multiplied by the haul road distance times two, to accommodate round-trips. When the VMT is not dependant on the amount of material being hauled (such as a pickup truck), the annual VMT is determined by multiplying the distance traveled per trip by an average number of trips per year. Dust suppression methods including watering and limiting travel speeds are applied to all traveled on-site roadways. Dust suppression methods of limiting travel speeds are applied to off-site haul roads.

Emission Equations:

$$E_{uc} = k * (s/12)^a * (W/3)^b$$

$$E_c = E_{uc} * [(100 - C) / 100]$$

Where:
E_{uc} = uncontrolled emission factor (lbs/VMT)
E_c = controlled emission factor (lbs/VMT)
k = Aerodynamic Particle Size Multiplier (unitless)
s = surface material silt content (%)
a = particle size multiplier constant (unitless)
W = mean vehicle weight (tons)
b = particle size multiplier constant (unitless)
C = control efficiency of surfactant used to mitigate fugitive dust emissions from roads (%)

Annual Uncontrolled PM_{10} emissions (tons/yr) = E_{uc} * (Annual VMT) * (ton/2000 lbs)
Hourly Uncontrolled PM_{10} emissions (lbs/hr) = E_{uc} * (hourly VMT)
Annual Controlled PM_{10} emissions (tons/yr) = E_c * (Annual VMT) * (ton/2000 lbs)
Hourly Controlled PM_{10} emissions (lbs/hr) = E_{uc} * (hourly VMT)

Data:

k_{PM10} =	1.5	[AP-42 13.2.2, Table 2]
k_{PM} =	4.9	[AP-42 13.2.2, Table 2]
$k_{PM2.5}$ =	0.15	[AP-42 13.2.2, Table 2]
s =	5.8 %	[average silt content for a haul road (to/from pit) at a taconite ore mining and processing facility (AP-42, 13.2.2)]
$a_{PM10,PM2.5}$ =	0.9	[AP-42 13.2.2, Table 2]
a_{PM} =	0.7	[AP-42 13.2.2, Table 2]
$b_{PM10,PM2.5}$ =	0.45	[AP-42 13.2.2, Table 2]
b_{PM} =	0.45	[AP-42 13.2.2, Table 2]
C_{OSR} =	74.8 %	[Onsite roads: emission control for low travel speeds and watering (44% + 55%); WRAP Fugitive Dust Handbook]
C_{HR} =	44.0 %	[Haul roads: emission control for low travel speeds; WRAP Fugitive Dust Handbook]

L_{hr} = Amount of material hauled per hour (tph)
L_{yr} = Amount of material hauled per year (tpy)
Annual VMT = Vehicle round-trips/year * D_{rt}
D_{rt} = On-Site Round-Trip Hauling Distance (miles)

Calculations for onsite roads:

Vehicle Type	Load Type	W (tons)	PM_{10} E_{uc} (lbs/VMT)	PM_{10} E_c (lbs/VMT)	L_{yr} (tons/year or gallons/year)[1]	L_{hr} (tons per hour or gallons/hour)[1]	Vehicle Capacity (tons/vehicle)	D_{rt}[2] (miles)	Annual VMT (VMT/yr)	Uncontrolled PM_{10} Emissions		Controlled PM_{10} Emissions		Controlled PM Emissions		Controlled $PM_{2.5}$ Emissions	
										Annual (tpy)	Hourly (lbs/hr)	Annual (tpy)	Hourly (lbs/hr)	Annual (tpy)	Hourly (lbs/hr)	Annual (tpy)	Hourly (lbs/hr)
Haul Truck	Ore	38	2.4	0.61	109,500	12.5	25	3.03	13278	16.13	3.68	4.06	0.93	15.36	3.51	0.41	0.09
Front-End Loader	Ore	23	2.0	0.49	109,500	13	7	0.16	2644	2.60	0.59	0.65	0.15	2.47	0.56	0.07	0.01
	Development Rock	22	1.9	0.48	54,750	6	4	0.14	1887	1.80	0.41	0.45	0.10	1.72	0.39	0.05	0.01
Pick-Up Truck	Various	3	0.78	0.20	N/A	N/A	N/A	3.15	2300	0.90	0.20	0.23	0.052	0.85	0.19	0.02	0.005
Water Truck	Dust Suppressant	19	1.8	0.45	N/A	N/A	8	3.15	1150	1.03	0.24	0.26	0.059	0.98	0.113	0.03	0.006

TABLE B-8
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
FUGITIVE UNPAVED ROAD EMISSIONS - CRITERIA POLLUTANTS

Tanker Truck	Fuel	24	2.0	0.50	40,000	N/A	18	2.98	24	0.02	0.01	0.01	0.00	0.02	0.1126	0.00	0.00
									TOTAL EMISSIONS FOR ALL ROAD TRAFFIC	**22.48**	**5.13**	**5.67**	**1.29**	**21.40**	**4.88**	**0.57**	**0.13**

N/A = not applicable

1 The Tanker Truck Vehicle Capacity is in units of gallons/vehicle
2 On-Site Round-Trip Hauling Distance is estimated for each vehicle type, based on the following routes:

Haul Truck	2*(Road A + Road B + Access Road)
Front-End Loader (Ore)	2*(Road B)
Front-End Loader (Dev Rock)	2*(Road E/2 + Road F)
Pick-Up Truck	Road A + Road B + Road C + Road D + Road E + Road F + (Road A)/2 + 2*Access Road
Water Truck	Road A + Road B + Road C + Road D + Road E + Road F + (Road A)/2 + 2*Access Road
Tanker Truck	2*((Road A)/2 + Road E + Road F + Access Road)

Calculations for offsite haul roads:

Vehicle Type	Load Type	W (tons)	PM_{10} E_{uc} (lbs/VMT)	PM_{10} E_c (lbs/VMT)	L_{yr} (tons/year or gallons/year)[1]	L_{hr} (tons per hour or gallons/hour)[1]	Vehicle Capacity (tons/vehicle)	D_{rt}[2] (miles)	Annual VMT (VMT/yr)	Uncontrolled PM_{10} Emissions		Controlled PM_{10} Emissions		Controlled PM Emissions		Controlled $PM_{2.5}$ Emissions	
										Annual (tpy)	Hourly (lbs/hr)	Annual (tpy)	Hourly (lbs/hr)	Annual (tpy)	Hourly (lbs/hr)	Annual (tpy)	Hourly (lbs/hr)
Haul Truck	Ore	38	2.4	1.36	109,500	12.5	25	70.75	309903	376.46	85.95	210.82	48.13	358.41	81.83	21.08	4.81
Front-End Loader	Ore	23	2.0	1.10	109,500	13	7	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Development Rock	22	1.9	1.07	54,750	6	4	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pick-Up Truck	Various	3	0.78	0.44	N/A	N/A	N/A	70.75	51651	20.14	4.60	11.28	2.57	19.17	4.38	1.13	0.26
Water Truck	Dust Suppressant	19	1.8	1.01	N/A	N/A	8	70.75	25825	23.20	5.30	12.99	2.966	22.08	0.113	1.30	0.30
Tanker Truck	Fuel	24	2.0	1.11	40,000	N/A	18	70.75	566	0.56	0.13	0.31	0.07	0.53	0.1126	0.03	0.01
									TOTAL EMISSIONS FOR ALL ROAD TRAFFIC	**420.35**	**95.97**	**235.40**	**53.74**	**400.19**	**86.43**	**23.54**	**5.37**

N/A = not applicable
1 The Tanker Truck Vehicle Capacity is in units of gallons/vehicle
2 Haul Road Round-Trip Hauling Distance is estimated for each vehicle type, based on the following routes:

Haul Truck	2*(Haul Roads A-D + Haul Road D-G)
Front-End Loader (Ore)	
Front-End Loader (Dev Rock)	
Pick-Up Truck	2* (Haul Roads A-D + Haul Road D-G)
Water Truck	2* (Haul Roads A-D + Haul Road D-G)
Tanker Truck	2*(Haul Roads A-D + Haul Road D-G)

TABLE B-9
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
FUGITIVE UNPAVED ROAD EMISSIONS - MODELING PARAMETERS

Emission Source: FUGITIVE DUST EMISSIONS FROM VEHICLE TRAFFIC
Pollutants: PM_{10}

Modeling Parameter Estimate From: ADEQ Air Dispersion Modeling Guidelines for Arizona Air Quality Permits
Road Emission Source Modeling Technique

Explanation: To represent road emissions as volume sources, the following eight steps were followed:

1. Determine the adjusted width of the road. The adjusted width is the actual width of the road plus 6 meters. The additional width represents turbulence caused by the vehicle as it moves along the road. This width will represent a side of the base of the volume.
2. Determine the number of volume sources, N. Divide the length of the road by the adjusted width. The result is the maximum number of volume sources that could be used to represent the road.
3. Determine the height of the volume. The height will be equal to twice the height of the vehicle generating the emissions – rounded to the nearest meter.
4. Determine the initial horizontal sigma for each volume.
   a. If the road is represented by a single volume, divide the adjusted width by 4.3.
   b. If the road is represented by adjacent volumes, divide the adjusted width by 2.15.
   c. If the road is represented by alternating volumes, divide by twice the adjusted width (measured from the center point of the first volume to the center point of the next represented volume) by 2.15. Start with the volume nearest to the property line. This representation is often used for long roads.
5. Determine the initial vertical sigma. Divide the height of the volume determined in Step 3 by 2.15.
6. Determine the release point. Divide the height of the volume by two. This point is the center of the volume.
7. Determine the emission rate for each volume used to calculate the initial horizontal sigma in Step 4. Divide the total emission rate equally among the individual volumes used to represent the road, unless there is a known spatial variation in emissions.
8. Determine the UTM coordinate for the release point. The release point location is in the center of the base of the volume. This location must be at least one meter from the nearest receptor.

Road ID	Road Length (m)	Road Thickness (ft)	Road Thickness (m)	Road Adjusted Width (m)	Max Number of volume sources - N	Number of volume sources modeled[a]	Volume source spacing (m)	source height[b] (m)	sigma (y0)	sigma (z0)	Release Height (m)
Haul A-B	13565.8	32.00	9.75	15.75	861	431	31	9	14.7	4.25	4.572
Haul B-C	18788.1	32.00	9.75	15.75	1193	597	31	9	14.7	4.25	4.572
Haul C-D	14509.4	32.00	9.75	15.75	921	464	31	9	14.7	4.25	4.572
Haul D-G	10058.4	32.00	9.75	15.75	638	323	31	9	14.7	4.25	4.572
Access	2175.7	32.00	9.75	15.75	138	69	32	9	14.7	4.25	4.572
A	132.00	16.00	4.88	10.88	12	12	11	9	5.06	4.25	4.572
B	131.10	16.00	4.88	10.88	12	12	11	9	5.06	4.25	4.572
C	76.80	16.00	4.88	10.88	7	6	13	9	5.06	4.25	4.572
D	158.30	16.00	4.88	10.88	15	15	11	9	5.06	4.25	4.572
E	84.40	16.00	4.88	10.88	8	7	12	9	5.06	4.25	4.572
F	70.10	16.00	4.88	10.88	6	7	10	9	5.06	4.25	4.572

(a) The road emissions are to be represented as alternating volume sources in modeling.
by representing two source lengths as a single volume source. The number of volume sources was adjusted in some cases according to site layout restrictions.

(b) Truck height assumed to be 15 ft.

TABLE B-10
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
FUGITIVE FUEL STORAGE TANK EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **Fugitive Emissions from Fuel Storage Tanks**
Pollutants: **VOCs**

Emission Estimate From: **EPA TANKS 4.0.9D Storage Tank Emissions Calculation Software (2005)**

Explanation: TANKS 4.0.9D is a Windows-based computer software program that estimates volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions from fixed- and floating-roof storage tanks. Storage tank specifications provided by International Uranium Corporation were used as input into the EPA TANKS model. The TANKS model output files are attached in Appendix M.

Annual PM_{10} Emissions:

Storage Tank	Contents	Tank Volume (gallons)	Tank Orientation	Tank Length (ft)	Tank Width (ft)	Tank Height (ft)	Equivalent Diameter (ft)	Average Liquid Height (ft)	Turnovers per Year per Tank	Annual VOC Emissions		
										(lbs/year)	(tons/year)	(lbs/hr)
AST #1	Unleaded gasoline	3,000	H	12.0	7.25	5.50	6.3	2.8	1	590	2.95E-01	6.73E-02
AST #2	Diesel	6,000	H	15.5	8.00	8.75	8.4	4.4	6	1.60	2.65E-03	6.04E-04
Total										591	2.97E-01	6.79E-02

TABLE B-11
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
VENT SHAFT EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **VENT SHAFT**
Pollutants: **PM, PM_{10}, $PM_{2.5}$**

Emission Factor From: **MSHA**

Explanation: A vent shaft is used at the Arizona 1 Mine for mine aeration and air circulation. The vent shaft may have particulate emissions due to underground activities. The vent shaft has a y-shaped vent shaft diffuser that splits the shaft into two surface openings. Emissions from each opening are calculated separately. A total particulate emission value is calculated by multiplying the ventilation rate from each vent opening by an emission factor for particulate emissions. Watering in the mine will be implemented to reduce particulate emissions.

Emission Equations:

Hourly Emissions (lbs/hr) = VR * E * (%UC/100) * $(0.3048m/ft)^3$ * (g/1000 mg) * (lb/453.56 g) * (60 min/hr)

Annual Emissions (tons/yr) = Hourly Emissions (lbs/hr) * OH * (ton/2000 lbs)

Where:
VR = ventilation rate (actual ft^3/min)
E = particulate emission factor (mg/m^3)
%UC = percentage of time in up cast mode (%)
OH = annual operating hours (hrs/yr)
C = control efficiency (%)

Data:

OH =	8760	hrs/yr	
E =	1	mg/m^3 PM/PM_{10}	Recommended by the Mine Safety and Health Administration (MSHA) and is consistent with the National Institute for Occupational Safety and Health (NIOSH) recommendation that worker exposure to coal dust be limited to 1.0 milligram per cubic meter over a 40-hour work week.
C =	62	%	(assumed for material handling water application, based on Table 4-2 of the Western Regional Air Partnership (WRAP) Fugitive Dust Handbook)

Vent Hole Emissions Estimate:

Mine	Vent Hole ID	VR	Fan Type	%UC[1]	Hourly Uncontrolled $PM/PM_{10}/PM_{2.5}$ Emissions per Vent[2]	Annual Uncontrolled $PM/PM_{10}/PM_{2.5}$ Emissions per Vent[2]	Hourly Controlled $PM/PM_{10}/PM_{2.5}$ Emissions per Vent[2]	Annual Controlled $PM/PM_{10}/PM_{2.5}$ Emissions per Vent[2]
	--	(ft^3/min)	--	(%)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)
Arizona 1	AZIVent1	110,000	Up Cast	100%	0.41	1.80	0.16	0.69
	AZIVent2	110,000	Up Cast	100%	0.41	1.80	0.16	0.69
Total Arizona I Mine Vent Hole Emissions					*0.82*	*3.61*	*0.31*	*1.37*

1 Fans in the down cast mode predominantly pull air from ambient air into the vent shaft; no particulates will be released to ambient air during down cast operation.
2 It was assumed in this analysis that 100% of the PM is $PM_{2.5}$.

TABLE B-12
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
GENERATOR EMISSIONS - HAZARDOUS AIR POLLUTANTS

Explanation: The Arizona 1 Mine receives its prime power from overhead electrical lines. One generator is used as a backup in the event of power outage or generator maintenance. The emission estimates are based on one 400-kW backup generator using No. 2 fuel oil, and on specifications from the generator manufacturer and AP-42 emission factors as noted.

Emission Equations: **Hourly (lbs/hr)=PR * (1.341 hp/kW)*(2544 btu/hr/hp)*(mmbtu/$10^{6\ btu}$)*E (lb/mmbtu)**
Annual (tons/yr) = Hourly Emissions (lbs/hr) * OH * (ton/2000 lbs)

Total Emissions = Emissions per Unit * Number of Units

Where:
PR = generator power rating (kW)
E = emission factor (lb/mmBTU)
OH = annual operating hours (hours/year)

Data:
PR (400 kW) = 400 kW
OH (400 kW) = 120 hours/year

Generator Emissions Estimate

Pollutant	Emission Factor	Units	Source	Hourly Emissions (lb/hr)	Annual Emissions (lb/yr)	Annual Emissions (ton/yr)	Chemical Abstract Services (CAS) Number
Naphthalene	8.48E-05	lb/mmBtu	AP-42 (10/96) Table 3.3-2	1.16E-04	1.39E-02	6.94E-06	91-20-3
Acetaldehyde	7.67E-04	lb/mmBtu	AP-42 (10/96) Table 3.3-2	1.05E-03	1.26E-01	6.28E-05	75-07-0
Acrolein	9.25E-05	lb/mmBtu	AP-42 (10/96) Table 3.3-2	1.26E-04	1.51E-02	7.57E-06	107-02-8
Benzene	9.33E-04	lb/mmBtu	AP-42 (10/96) Table 3.3-2	1.27E-03	1.53E-01	7.64E-05	71-43-2
1,3-Butadiene	3.91E-05	lb/mmBtu	AP-42 (10/96) Table 3.3-2	5.34E-05	6.40E-03	3.20E-06	106-99-0
Formaldehyde	1.18E-03	lb/mmBtu	AP-42 (10/96) Table 3.3-2	1.61E-03	1.93E-01	9.66E-05	50-00-0
Toluene	4.09E-04	lb/mmBtu	AP-42 (10/96) Table 3.3-2	5.58E-04	6.70E-02	3.35E-05	108-88-3
Xylenes	2.85E-04	lb/mmBtu	AP-42 (10/96) Table 3.3-2	3.89E-04	4.67E-02	2.33E-05	1330-20-7
Total HAPs	**3.79E-03**	**lb/mmBtu**	**AP-42 (10/96) Table 3.3-2**	**5.17E-03**	**6.21E-01**	**3.10E-04**	--

Note:
No Inorganic HAPs emission factors provided in AP-42, Section 3.3

Diesel generator output:	400	kw	
Diesel engine output:	536	hp	1.341 hp/kw
Diesel engine output:	1.36	MMbtu/hr	1hp = 2544 Btu/hr
Maximum Annual Hours:	120	hours/year	

TABLE B-13
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
ORE AND DEVELOPMENT ROCK EMISSIONS - HAZARDOUS AIR POLLUTANTS

Controlled Emissions

	PM_{10}		Arsenic		Lead		Nickel		Selenium		Uranium		Vanadium	
Development Rock Composition[1]			46.0 ppm		13.0 ppm		15 ppm		3.0 ppm		2.0 ppm		19 ppm	
Ore Sampling Composition[2]											6000 ppm		19 ppm	
Emissions Source Description[3]	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**
Vent Holes	0.31	2743.29	1.4E-05	1.3E-01	4.1E-06	3.6E-02	4.7E-06	4.1E-02	9.4E-07	8.2E-03	1.3E-03	1.1E+01	6.0E-06	5.2E-02
Front-End Loading Loading and Unloading	0.10	832.86	4.4E-06	3.8E-02	1.2E-06	1.1E-02	1.4E-06	1.2E-02	2.9E-07	2.5E-03	3.8E-04	3.3E+00	1.8E-06	1.6E-02
Ore and Dev Rock Storage Piles	0.04	313.12	1.6E-06	1.4E-02	4.6E-07	4.1E-03	5.4E-07	4.7E-03	1.1E-07	9.4E-04	8.8E-05	7.7E-01	6.8E-07	5.9E-03
Top Soil Storage Piles	0.02	0.00004	8.3E-07	1.8E-09	2.3E-07	5.1E-10	2.7E-07	5.9E-10	5.4E-08	1.2E-10	3.6E-08	7.9E-11	3.4E-07	7.5E-10
Total Rock HAP Emissions	**0.46**	**3,889.28**	**2.1E-05**	**0.18**	**6.0E-06**	**0.05**	**6.9E-06**	**0.06**	**1.4E-06**	**0.01**	**0.002**	**15.09**	**8.8E-06**	**0.07**

1 Chemical composition of HAPs in development rock is from 11 development rock samples from Arizona I mine.
2 Uranium composition in ore is based on uranium ore sample data for the Arizona 1 Mine. It has been assumed that composition of other metals in ore is similar to the composition in development rock. 3 It was assumed for the purposes of these calculations that top soil storage piles have the same mineral composition as development rock. It was also assumed that HAP emissions for other operations are based on percentage of ore and development rock associated with these operations. For the vent holes, it was assumed 67% of the PM makeup was ore and 33% was development rock, which is the same as the expected percentages of rock mined.

TABLE B-14
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
GASOLINE TANK EMISSIONS - HAZARDOUS AIR POLLUTANTS

Pollutant	Emission Factor	Units	Source	Hourly Emissions (lb/hr)	Annual Emissions (ton/yr)	Chemical Abstract Services (CAS) Number
Benzene	1.10	Percent of VOC Vapor	SPECIATE 3.2 Profile	7.40E-04	3.24E-03	71-43-2
Ethyl benzene	0.27	Percent of VOC Vapor	SPECIATE 3.2 Profile	1.82E-04	7.96E-04	100-41-4
Hexane	1.79	Percent of VOC Vapor	SPECIATE 3.2 Profile	1.20E-03	5.28E-03	110-54-3
Styrene	1.00E-02	Percent of VOC Vapor	SPECIATE 3.2 Profile	6.73E-06	2.95E-05	100-42-5
Toluene	3.13	Percent of VOC Vapor	SPECIATE 3.2 Profile	2.11E-03	9.23E-03	108-88-3
2,2,4-Trimethylpentane	1.47	Percent of VOC Vapor	SPECIATE 3.2 Profile	9.90E-04	4.33E-03	540-84-1
Xylenes	1.27	Percent of VOC Vapor	SPECIATE 3.2 Profile	8.55E-04	3.74E-03	1330-20-7
Total Organic HAPs	-	**Percent of VOC Vapor**	**SPECIATE 3.2 Profile**	**6.09E-03**	**2.67E-02**	-

Note:
Emission estimates based on emission factors provided in the US EPA SPECIATE 3.2 database for "Composite of 14 Gasoline Headspace Vapor Samples - 1996" (Profile 2453).

TABLE B-15
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
DIESEL TANK EMISSIONS - TOXIC POLLUTANTS

Pollutant	Emission Factor	Units	Source	Hourly Emissions (lb/hr)	Annual Emissions (ton/yr)	Chemical Abstract Services (CAS) Number
Benzene	2.57	Percent of VOC Vapor	SPECIATE 3.2 Profile	1.55E-05	6.80E-05	71-43-2
Ethyl benzene	0.32	Percent of VOC Vapor	SPECIATE 3.2 Profile	1.93E-06	8.46E-06	100-41-4
Hexane	5.61	Percent of VOC Vapor	SPECIATE 3.2 Profile	3.39E-05	1.48E-04	110-54-3
Toluene	2.06	Percent of VOC Vapor	SPECIATE 3.2 Profile	1.24E-05	5.45E-05	108-88-3
Xylenes	0.13	Percent of VOC Vapor	SPECIATE 3.2 Profile	7.85E-07	3.44E-06	1330-20-7
Total Organic HAPs	-	**Percent of VOC Vapor**	**SPECIATE 3.2 Profile**	**6.46E-05**	**2.83E-04**	-

Note:
Emission estimates based on emission factors provided in the US EPA SPECIATE 3.2 database for "Composite of 9 Emission Profiles from Distillate Oil Storage Tanks - 1993" (Profile 2488).

TABLE B-16
ENERGY FUELS RESOURCES (USA) INC. - ARIZONA 1 MINE
GENERATOR EMISSIONS - GREENHOUSE GAS POLLUTANTS

Emission Source: **GENERATORS; 40 CFR Part 98, Table C-1**
Calculation Notes: Calculations are based on specifications from the generator manufacturer and the EPA GHG Reporting Rule.

Emission Equations: **Annual emissions (metric tons/yr) = 1 x 10^{-3} * Fuel * HHV * EF**
Total Emissions = Emissions per Unit * Number of Units

Where:
1×10^{-3} = Conversion from kg to metric tons
Fuel = Mass or volume of fuel combusted per year
HHV = Default high heat value of fuel
EF = Fuel emission factor

Data:	HHV (#2 Fuel Oil) =	0.138	mmBTU/gallon	
	CO_2 EF =	73.96	kg/mmBTU	
	CH_4 EF =	3.00E-03	kg/mmBTU	
	N_2O EF =	6.00E-04	kg/mmBTU	
Power Rating (PR):	PR (400) =	400	kW	
Fuel Usage (F):	F (400) =	56.3	gal/hr	
Operation hours (OH):	OH (400) =	120	hrs/yr	

Global Warming Potential (GWP)

CO_2 =	1
CH_4 =	21
N_2O =	310

Emissions Estimate:

Generator	Generator Rating (kW)	Pollutant	Emission Factor per Unit	Units	Emission Factor Source	Annual Emissions (kg/year)	Annual Emissions (metric tons/yr)	Annual Emissions (short tons/yr)
400	400	CO_2	73.96	kg/mmBTU	40 CFR Part 98, Table C-1	68,955	69	76
		CH_4	3.00E-03	kg/mmBTU	40 CFR Part 98, Table C-1	2.8	0.003	0.003
		N_2O	6.00E-04	kg/mmBTU	40 CFR Part 98, Table C-1	0.6	0.001	0.001
					CO_2e	**69,187**	**69**	**76**

Denison Mines (USA) Corp.

Class II Permit Application for the Proposed Arizona I Mine Project

Submitted to:

Arizona Department of Environmental Quality
Air Quality Division
1110 West Washington Street
Phoenix, Arizona 85007

Prepared by:

Tetra Tech EM Inc.
950 17th Street
Suite 2200
Denver, Colorado 80202

January 2008

CONTENTS

SECTION **Page**

CONTENTS (Continued)

APPENDIX

FIGURES

CONTENTS (Continued)

TABLES

1.0 INTRODUCTION

This document presents information on technical and regulatory compliance in support of a Class II Standard Permit Application for the Arizona Department of Environmental Quality (ADEQ) Air Quality Division (AQD). The ADEQ Standard Permit Application Form is provided in Appendix A.

Denison Mines (USA) Corp. (Denison) is proposing to reactivate the Arizona I Mine located on the Kanab Plateau in Mohave County, Arizona. The Arizona I Mine is located 35 miles south of Fredonia, Arizona, as shown in Figure 1-1. The location of the site in Mohave County is within an area that is currently classified as an attainment or unclassifiable area for air quality. Figure 1-2 illustrates the proposed site in relation to the surrounding topography. Denison holds unpatented mining claims associated with the proposed mining operation at the Arizona I Mine site.

The mine was originally developed in 1988 and initial mine development work was conducted in the late 1980s and early 1990s. In 1988, the site owner submitted a major modification to the existing Plan of Operation to allow the owner to expand the nature and duration of the activities authorized. The mine was placed on standby in the early 1990s because of low uranium prices. In light of rising uranium prices, Denison now plans to reactivate the mine by rehabilitating the surface facilities and further developing the underground workings using the existing shaft. Denison currently holds sole claim rights to and permitting responsibility for the Arizona I Mine.

Sources of air emissions associated with the Arizona I project will include one standby diesel generator, ore and development rock storage and handling, and other fugitive emissions. Based on estimations of total facility emissions, the Arizona I project will be a minor (Class II) source. There will be no on-site processing (physical or chemical) of ore at the mines; accordingly, there will be no tailings or reject material (such as crusher fines).

This document contains the following sections that will serve to meet the ADEQ permit application requirements. Section 2.0 describes the proposed project. Section 3.0 discusses air emissions associated with the proposed facilities. Section 4.0 provides citations and descriptions of all applicable requirements. Section 5.0 describes the proposed compliance plan for the project. Section 6.0 presents an air quality impact analysis for the proposed source configuration. Section 7.0 presents references.

Appendix A contains all required ADEQ Permit Application Forms. Appendix B provides detailed emission calculations. Appendix C contains specifications for the generator. Appendix D contains

TANKS model output. Appendix E contains detailed SCREEN3 model results. Appendix F provides VISCREEN model results. Appendix G contains a CD-ROM of the electronic modeling files.

Arizona 1

White Mesa Mill

Limited Access

Highway

Major Road

N

W E

S

0 60

Miles

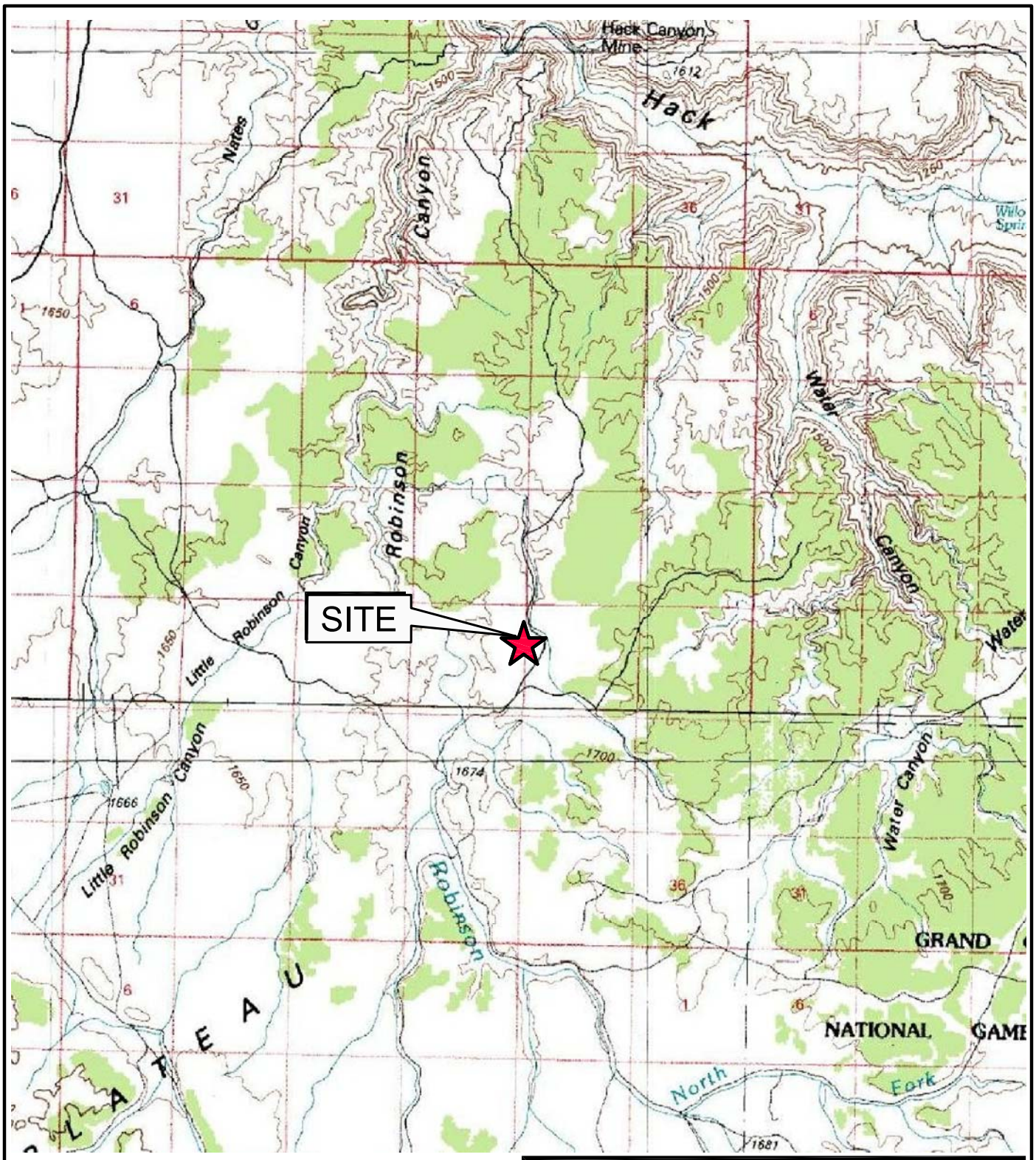
DENISON MINES

Project: ARIZONA 1 MINE			
County: Mohave	State: AZ	Location: T36N R5W Sec. 22&23	
DSGN: CW	DRN: KC	Date: 01/17/2008	Revision:

FIGURE 1-1
SITE LOCATION

TETRA TECH EM INC.

S:\Project\DUSA\P4214.002 CADD GIS support\Arizona\Arizona-1\GIS\projects\Az1_Locaton.mxd TtEMI-DN Kurt.Cholak



SOURCE: TerraServer USA, 1988

1000 0 1000 2000

SCALE: IN METERS

Coordinate System:
UTM Zone 12, NAD 83

DENISON MINES

Project	ARIZONA 1 MINE				
County: Mohave	State: Arizona	Location:			
DSGN: DMF	DRN: DMF	DATE: 04/05/2007	REVISION:		

FIGURE 1-2
TOPOGRAPHIC BASE MAP

TETRA TECH EM INC.

S:\Project\DUSA\P4214.002 CADD GIS support\Arizona\Arizona-1\CAD\UTM\ Fig 1-2_Arizona-1 Site Topo.dwg 01/14/2008 deborah.ford DN

2.0 PROJECT DESCRIPTION

Denison is proposing to reactivate the Arizona I Mine. The site is generally located at Universal Transverse Mercator (UTM) coordinates 338,280 meters east and 4,041,779 meters north (North American Datum [NAD] 83). The layout of the Arizona I Mine in relation to the Project Area Boundary (PAB) is presented in Figure 2-1.

The proposed maximum daily mine production rate is 500 tons per day (182,500 tons per year [tpy]) of uranium ore. Access to the ore deposit will be by a conventional, three-compartment vertical shaft located immediately north of the deposit.

Raises or incline workings within the mine connect the various levels within, or very near, the deposit. Sublevel workings will be driven to extract ore from the deposit at various elevations from these levels. The broken ore will be dropped down raises, designed for this use, to drawpoints on the lowest level. The ore will then be hauled to the shaft, where it will be transferred to skips in the shaft and hoisted to the surface. Barren waste rock generated during mining will be removed and disposed of on the surface in the waste disposal areas. Ore will be stockpiled on the surface near the shaft until it is shipped to the White Mesa Mill near Blanding, Utah.

Ore will be loaded using a front-end loader into 25-ton, over-the-road haul trucks for transportation to the off-site processing mill. If the ore cannot be shipped immediately to the mill, the front-end loader will stack the ore in nearby stockpiles within the Ore Stockpile Area (OSA). The OSA will encompass one acre and can accommodate up to 9,680 tons of stockpiled ore.

Waste rock from the mining operations will initially be disposed of in the Waste Rock Area (WRA) and in mined-out areas of the underground workings. The WRA will encompass 1.25 acres.

An existing topsoil pile will be present on the site, but will not be affected by resumption of operations. The pile has been seeded and will only produce minor emissions from wind erosion.

LEGEND

- PROPOERTY BOUNDARY
- FENCE
- UTILITY LINE
- ROAD
- BERM
- FLOW DIRECTION
- VENT SHAFT
- EMISSION POINT

N

30 0 30 60

SCALE: IN METERS

UTM Zone 12 Coordinate System
NAD 83

DENISON MINES

Project: ARIZONA 1 MINE			
County: Mohave	State: Arizona	Location: Section 22 & 23, T36N, R5W	
DSGN: DMF	DRN: DMF	DATE: 04/05/2007	REVISION:

FIGURE 2-1
SITE PLAN

TETRA TECH EM INC.

S:\Project\DUSA\P4214.002 CADD GIS support\Arizona\Arizona-1\CAD\UTM\ Figure 2-1_Arizona-1 Site Boundary Repcetors.dwg 01/14/2008 deborah.ford DN

The Arizona I Mine is secured by a gate located at the surface facilities area and active portal. A security fence also has been installed around the project area. The mine site will be secured when it is unattended.

Power for the Arizona I Mine will be supplied via overhead electric lines. One generator may be used as a source of backup power in the event of power failure. This generator is a pre-1978, 400-kilowatt (kW) Cummins stationary diesel-powered generator.

The primary road into the site is a north-south county road that connects with an east-west county road just south of the site. On-site traffic will travel within the PAB, accessing ore stockpiles, the waste rock pile and maintenance facilities. Surface equipment that will travel on on-site roads includes:

- Front-End Loaders
- Backhoe/Skid Loader
- Highway Haul Trucks
- Water Truck
- Fuel Truck
- Pick-up Trucks

Diesel fuel, gasoline, and other petroleum products may be stored on site in aboveground storage tanks (ASTs), drums, and smaller containers. The fueling station will be located in the southern portion of the site, adjacent to the WRA, and will contain one 6,000-gallon diesel fuel tank. One 3,000-gallon gasoline tank, not currently located on the site, may be added in the future. Modeling will be completed assuming the gasoline tank is present. New oils will be in 55-gallon drums, with no more that 10 drums stored at the mine at one time. Used oil will be stored in 55-gallon drums for pick-up by a disposal firm. No more than four drums will be stored at the mine at one time. All lubrication oils will be stored under cover and over a concrete containment. Emissions from gasoline and diesel storage tanks will be included in the emission inventory.

Two vent shafts are located on the site. These shafts are required under safety protocols for mine operations. Emissions of criteria pollutants are expected to be very low, based on distances of emission sources in the mine to vent openings. Watering required under safety regulations (Mine Safety and Health Administration [MSHA] regulations at Title 30 Code of Federal Regulations [CFR] Part 57) will also reduce potential emissions from mining. Tetra Tech EM Inc. (Tetra Tech) was informed by ADEQ (ADEQ 2007b) that no state requirements address emissions from vent shafts, other than those required

under the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) regulation which requires radon monitoring.

3.0 PROJECTED EMISSIONS

This section presents emissions data for criteria pollutants. Criteria pollutants include:

- Nitrogen dioxide (NO_2) – measured as nitrogen oxides (NO_X)
- Carbon monoxide (CO)
- Volatile organic compounds (VOCs)
- Particulate matter with a diameter of 10 microns or less (PM_{10})
- Sulfur dioxide (SO_2)
- Lead (Pb)

Summaries of facility wide emissions are shown in Tables 3-1 and 3-2. Table 3-1 presents the total projected facility-wide annual emissions, accounting for emission controls. Table 3-2 presents projected facility-wide short-term emission rates.

Generally, emissions have been calculated using engineering design specifications or standard emission calculation equations, such as AP-42. Details of emissions calculations for all Arizona I Mine sources are provided in Appendix B.

SO_2, CO, NO_X, PM_{10}, and VOC emission estimates for the 400-kW standby generator are based on emission factors provided in the U.S. Environmental Protection Agency (EPA) Compilation of Air Pollutant Emission Factors (AP-42) Table 3.3-1 (EPA 1996). Specifications for the proposed generator are included in Appendix C.

Material handling emissions have been quantified for worst case modeling conditions and include wind erosion emissions from storage piles. Fugitive emissions from on-site roads have been estimated using AP-42 calculations.

Emissions from gasoline and diesel storage tanks were estimated using the EPA TANKS software. Output from the TANKS model is provided in Appendix D.

TABLE 3-1

DENISON MINES (USA) CORP – ARIZONA I MINE
PROJECTED FACILITY-WIDE ANNUAL EMISSIONS (TONS PER YEAR)

EMISSIONS	Generator	Material Handling Sources	Storage Pile Fugitive Sources	Road Fugitive Sources	Storage Tank Emissions	Total (tons/yr)
Criteria Pollutants						
CO	0.21	--	--	--	--	**0.2**
NOx	1.0	--	--	--	--	**1.0**
PM_{10}	0.071	0.69	0.16	6.23	--	**7.2**
VOC	0.08	--	--	--	0.297	**0.38**
SO_2	0.07	--	--	--	--	**0.07**
Lead	--	5.02E-14	2.28E-13	9.07E-12	--	**9.35E-12**

'--' Emissions of compound are either not present or were not reported in the literature reviewed.

TABLE 3-2

DENISON MINES (USA) CORP – ARIZONA I MINE
PROJECTED FACILITY-WIDE SHORT TERM EMISSIONS (POUNDS PER HOUR)

EMISSIONS	Generators	Material Handling Sources	Storage Pile Fugitive Sources	Road Fugitive Sources	Storage Tank Emissions	Totals
Criteria Pollutants						
CO	3.58	--	--	--	--	**3.58**
NOx	16.63	--	--	--	--	**16.63**
PM_{10}	1.18	0.16	0.04	1.07	--	**2.44**
VOC	1.35	--	--	--	0.07	**1.42**
SO_2	1.10	--	--	--	--	**1.10**
Lead	--	4.58E-08	2.08E-07	6.20E-06	--	**6.46E-06**

'--' Emissions of compound are either not present or were not reported in the literature reviewed.
NA - not available

4.0 APPLICABLE REQUIREMENTS

Requirements applicable to the proposed project are listed below.

4.1 ARIZONA ADMINISTRATIVE CODE – TITLE 18 ENVIRONMENTAL QUALITY

The following sections describe articles within the Arizona Administrative Code (AAC) and their applicability to the proposed project.

4.1.1 Article 1 – General

This article contains Definitions (R18-2-101); Incorporated Materials (R18-2-102); and Applicable Implementation Plan; Savings (R18-2-103). These sections contain the framework of Title 18 and are applicable to this project such that Title 18 is applicable to this project.

4.1.2 Article 2 – Ambient Air Quality Standards; Area Designations; Classifications

Ambient air quality standards for particulate matter, sulfur oxides (sulfur dioxide), ozone, carbon monoxide, nitrogen dioxide, and lead are established in this article. Designation of attainment, nonattainment, and unclassifiable areas according to 40 CFR 81.303 are incorporated by rule. Acceptable ambient air quality monitoring methods and procedures are identified. Methods of interpretation of ambient air quality standards and evaluation of air quality data are defined. Designation and classification of attainment areas are identified, and limitations of pollutants in classified attainment areas are defined. Violations are defined, as are air pollution emergency episodes.

Generally, this article applies to the State of Arizona as a whole. This project, as a contributor to emissions within Arizona, will be subject to the requirements identified within this article.

4.1.3 Article 3 – Permits and Permit Revisions

The following sections of this article apply to this project, either by defining all potentially applicable requirements of the ADEQ permitting program, or through defining requirements that will be specific to this project:

R18-2-301. Definitions
R18-2-302. Applicability; Classes of Permits
R18-2-303. Transition from Installation and Operating Permit Program to Unitary Permit Program
R18-2-304. Permit Application Processing Procedures

R18-2-305. Public Records; Confidentiality
R18-2-306. Permit Contents
R18-2-307. Permit Review by the EPA and Affected States
R18-2-308. Emission Standards and Limitations
R18-2-309. Compliance Plan; Certification
R18-2-310. Affirmative Defenses for Excess Emissions Due to Malfunctions, Startup, and Shutdown
R18-2-310.01. Reporting Requirements
R18-2-311. Test Methods and Procedures
R18-2-312. Performance Tests
R18-2-314. Quality Assurance
R18-2-315. Posting of Permit
R18-2-317.01 Facility Changes that Require a Permit Revision – Class II
R18-2-317.02 Procedures for Certain Changes that do not Require a Permit Revision – Class II
R18-2-318. Administrative Permit Amendments
R18-2-318.01. Annual Summary Permit Amendments for Class II Permits
R18-2-319. Minor Permit Revisions
R18-2-320. Significant Permit Revisions
R18-2-321. Permit Reopenings; Revocation and Reissuance; Termination
R18-2-322. Permit Renewal and Revocation
R18-2-323. Permit Transfers
R18-2-325. Permit Shields
R18-2-326. Fees Related to Individual Permits
R18-2-327. Annual Emission Inventory Questionnaire
R18-2-328. Conditional Orders
R18-2-330. Public Participation
R18-2-331. Material Permit Condition
R18-2-332. Stack Height Limitation

4.1.4 Article 4 – Permit Requirements for New Major Sources and Major Modifications to Existing Major Sources

This article does not apply to the proposed project. Proposed project emissions classify it as a minor source.

4.1.5 Article 5 – General Permits

This article does not apply to the proposed project. The proposed project does not fall within any of the general permit categories.

4.1.6 Article 6 – Emissions from Existing and New Nonpoint Sources

The following sections of this article apply to this project:

R18-2-601. General – defines applicability
R18-2-605. Roadways and Streets – defines emission requirements
R18-2-606. Material Handling – defines emission requirements
R18-2-607. Storage Piles – defines emission requirements
R18-2-614. Evaluation of Nonpoint Source Emissions – defines opacity requirements

4.1.7 Article 7 – Emissions from Stationary Source Performance Standards

This article does not apply to the proposed project because the proposed project does not meet all of the criteria listed in R18-2-702 A, which defines applicability.

4.1.8 Article 8 – Emissions from Mobile Sources (New and Existing)

R18-2-801 (Classification of Mobile Sources) defines the applicability of this regulation.
R18-2-802 (Off-road Machinery) defines engine smoke emission requirements for trucks, graders, scrapers, rollers, locomotives, and other construction and mining machinery that are not normally driven on a completed public roadway.

All other sections of this article do not apply to the proposed project.

4.1.9 Article 9 – New Source Performance Standards

R18-2-905 (Standards of Performance for Storage Vessels for Petroleum Liquids) will apply to the proposed site.

Some requirements of 40 CFR 60, New Source Performance Standards (NSPS), have been incorporated by reference as applicable requirements. R18-2-901 (Standards of Performance of New Stationary Sources) 1 Subpart A – General Provisions, will apply to the proposed site. All other cited standards do not apply to the proposed site. The requirements cited in Article 9 do not include reference to 40 CFR 60, Subpart IIII, as promulgated in July 2005.

40 CFR 60, Subpart IIII (Standards of Performance for Stationary Compression Ignition Internal Combustion Engines) will apply to the proposed site, if deemed applicable. Based on the purchase of a 1978 Cummins VT 12-700 generator for use at this site, this subpart is not applicable.

4.1.10 Article 10 – Motor Vehicles; Inspection and Maintenance

This article does not apply to the proposed project. It is assumed that vehicles entering the site comply with this regulation. However, the site owner takes no responsibility for ensuring compliance.

4.1.11 Article 11 – Federal Hazardous Air Pollutants

Some requirements of 40 CFR 61, NESHAPs, and 40 CFR 63 NESHAPs for Source Categories have been incorporated by reference as applicable requirements. R18-2-1101 (National Emission Standards for Hazardous Air Pollutants) A.1 Subpart A – General Provisions, and B.1 Subpart A – General Provisions,

apply to the proposed site. All other cited standards do not apply to the proposed site. The requirements cited in Article 11 do not include reference to 40 CFR 61, Subpart B, revised as of July 1, 2004.

Based on the proposed uranium ore production rate of 182,500 tons per year, this source may be subject to NESHAPs, 40 CFR 61 Subpart B, National Emission Standards for Radon Emissions from Underground Uranium Mines (Rad-NESHAP). Mines subject to this regulation may not emit radon-222 (Rn-222) to the ambient air in excess of amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 millirem per year (mrem/yr). Denison will comply with the applicable requirements of the Rad-NESHAP at the proposed Arizona I Mine.

4.1.12 Article 12 – Emissions Bank

This article does not apply to the proposed project because the project does not anticipate using the Emissions Bank program.

4.1.13 Article 13 – Diesel Conversion Grant Program

This article does not apply to the proposed project.

4.1.14 Article 14 – Conformity Determinations

This article does not apply to the proposed project.

4.1.15 Article 15 – Forest and Range Management Burns

This article does not apply to the proposed project.

4.1.16 Article 16 – Visibility; Regional Haze

This article does not apply to the proposed project because it is being permitted as a new source.

4.1.17 Article 17 – Arizona State Hazardous Air Pollutants Program

The provisions of this article do not apply to the proposed site because it does not meet the applicability requirements detailed in R18-2-1702.

5.0 COMPLIANCE

5.1 COMPLIANCE PLAN

The applicant will comply with the applicable requirements as defined in R18-2-101. (See Section 4.0 for a detailed list of applicable requirements.)

The applicant will comply with the applicable requirements of Article 6 of R18-2, specifically:

1. R18-2-601, general requirements;
2. R18-2-605 roadways and streets;
    a. Denison will not cause, suffer, allow or permit the use, construction or reconstruction of a roadway or alley without taking reasonable precautions to prevent excessive amounts of particulate matter from becoming airborne. Dust and other particulates will be kept to a minimum by use of wetting down, detouring, reducing travel speeds or other reasonable means.
    b. Denison will not cause, suffer, allow or permit transportation of materials likely to give rise to airborne dust without taking reasonable precautions, such as wetting or covering the load, to prevent particulate matter from becoming airborne.
3. R18-2-606, emission requirements for material handling;
    a. Denison will not cause, suffer, allow or permit handling or transporting of materials or other operations likely to result in significant amounts of airborne dust without taking reasonable precautions, such as the use of wetting agents, and covering the load to prevent excessive amounts of particulate matter from becoming airborne.
4. R18-2-607, emission requirements for storage piles; and
    a. Denison will not cause, suffer, allow or permit organic or inorganic dust producing material to be stacked, piled, or otherwise stored without taking reasonable precautions such as wetting or covering to prevent excessive amounts of particulate matter from becoming airborne.
    b. Stacking and reclaiming machinery utilized at storage piles will be operated at all times with a minimum fall of material and in such a manner, or with the use of wetting agents, as to prevent excessive amounts of particulate matter from becoming airborne.
5. R18-2-614, opacity requirements for evaluation of non-point source emissions.
    a. Opacity of an emission from any nonpoint source will not be greater than 40% measured according to the Arizona Testing Manual, Reference Method 9.

The applicant will comply with the applicable requirements of Article 8 of R18-2, specifically:

6. R18-2-802, engine smoke emission requirements for trucks, graders, scrapers, rollers, locomotives, and other construction and mining machinery not normally driven on a completed public roadway.
    a. Denison will not cause, allow or permit to be emitted into the atmosphere from any off-road machinery, smoke with an opacity exceeding 40% for any period greater than 10 consecutive seconds. Visible emissions when starting cold equipment are exempt from this requirement for the first 10 minutes.

The applicant will comply with the applicable requirements of Article 9 of R18-2, specifically:

7. R18-2-905 Standards of Performance for Storage Vessels for Petroleum Liquids.
    a. Any petroleum liquid storage tank of less than 40,000 gallons capacity shall be equipped with a submerged filling device or acceptable equivalent as determined by the Director for the control of hydrocarbon emissions.
    b. All facilities for dock loading of petroleum products having a vapor pressure of 2.0 pounds per squared inch absolute, or greater, at loading pressure shall provide for submerged filling or other acceptable equivalent for control of hydrocarbon emissions.
    c. All pumps and compressors which handle volatile organic compounds shall be equipped with mechanical seals or other equipment of equal efficiency to prevent the release of organic contaminants into the atmosphere.

Some requirements of 40 CFR 60, NSPS, have been incorporated by reference as applicable requirements. R18-2-901 (Standards of Performance of New Stationary Sources) Subpart A – General Provisions, will apply to the proposed site. The applicant will comply with the requirements of R18-2-901 1, Subpart A.

Some requirements of 40 CFR 61, NESHAPs, and 40 CFR 63 NESHAPs for Source Categories have been incorporated by reference as applicable requirements. R18-2-1101 (National Emission Standards for Hazardous Air Pollutants) A.1 Subpart A – General Provisions, and B.1 Subpart A – General Provisions, apply to the proposed site. The applicant will comply with the requirements of R18-2-1101 A.1 Subpart A and B.1 Subpart A.

The applicant will comply with the requirements of 40 CFR 61, Subpart B – National Emission Standards for Radon Emissions from Underground Uranium Mines.

As prescribed by 40 CFR 61, Subpart B, Denison will conduct Rn-222 testing in accordance with the procedures described in 40 CFR 61 Appendix B, Method 115, Section 1 (Radon-222 Emissions from Underground Uranium Mine Vents). Specifically, Denison proposes to test Rn-222 emissions per Sections 1.1.1 (Continuous Measurement) and 1.2 (Test Methods and Procedures). Section 1.1.1 specifies that the concentration of Rn-222 must be continuously measured at each mine vent whenever the mine ventilation system is in operation. Weekly Rn-222 emission rates will be calculated and recorded for each week using monthly Radon concentration data and quarterly ventilation rate measurements. Denison will begin testing emissions from the vent holes within 90 days after initial mine startup, as prescribed in 40 CFR 61.13. Method 115 also stipulates that the exhaust flow rate from each mine vent must be measured at least four times per year. Denison will comply with this requirement.

Method 115, Section 1.2 specifies test methods to be used to measure velocity traverses (40 CFR 60 Appendix A, Method 1) and velocity and volumetric flow rates (40 CFR 60 Appendix A, Method 2). Two options are presented for analysis of Rn-222 (Method A-6 or Method A-7 of 40 CFR 61 Appendix B, Method 114). Denison proposes to use Method A-7 to analyze Rn-222. Denison will use commercially-available, alpha track Rn-222 detectors to continuously collect Rn-222 emissions on a monthly basis throughout the report year. Denison has used this methodology to fulfill similar EPA requirements at other operational mines. Radon detectors will be installed in the mine vent air streams. A new radon detector will be installed in each mine vent air stream at the end of each month, and spent radon detectors will be sent to a qualified off-site laboratory to be read.

Denison will use the resulting Rn-222 and flow rate measurements to calculate the effective dose equivalent resulting from mine emissions. The EPA computer code COMPLY-R will be used, and the output from COMPLY-R will be compared with the 10 mrem/yr emission standard. Denison may also demonstrate compliance with the 10 mrem/yr emission standard through the use of computer models that are equivalent to COMPLY-R if the model has received prior approval from EPA headquarters. If Denison proposes to use a model other than COMPLY-R, Denison will submit a proposal for the model before it is used.

As per 40 CFR 61, Subpart B, Denison will calculate and report the results of the compliance modeling each year. This annual report will include the emissions of a calendar year and will be sent to EPA and

ADEQ by March 31st of the following year. Denison will include the following information in each annual report:

1. The name and location of the mine.
2. The name of the person responsible for operation of the facility and, if different, the name of the person who is preparing the report.
3. The results of the emissions testing conducted and the dose calculated.
4. A list of the stacks, vents, or other points where radioactive materials are released to the atmosphere, including their location, diameter, flow rate, effluent temperature, and release height.
5. A description of the effluent controls that are used on each stack, vent, or other release point if applicable; a description of the effluent controls used inside the mine if applicable; and an estimate of the efficiency of each control method or device.
6. Distances from the points of release to the nearest residence, school, business, or office and the nearest farms that produce vegetables, milk, and meat.
7. The values used for all other user-supplied input parameters for the computer model (such as meteorological data) and the source of these data.

Per the requirements of 40 CFR Part 61, Subpart B, each report will be signed and dated by a corporate officer in charge of the facility and will contain the following declaration immediately above the signature line: "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001."

If the mine does not comply with the 10 mrem/yr emission standard in the calendar year covered by the report, Denison will report Rn-222 emissions to the EPA and ADEQ on a monthly basis. The first monthly report would include emissions from March of that year and would be due April 30. Subsequent reports would be due 30 days after the end of the month. Denison would submit these monthly reports to EPA and ADEQ until the EPA or ADEQ determined that the monthly reports are no longer necessary. Denison would include the following information in each monthly report:

1. The name and location of the mine.

2. The name of the person responsible for the operation of the facility and, if different, the name of the person who is preparing the report.
3. The results of the emissions testing conducted and the dose calculated.
4. A list of the stacks, vents, or other points where radioactive materials are released to the atmosphere, including their location, diameter, flow rate, effluent temperature, and release height.
5. A description of the effluent controls that are used on each stack, vent, or other release point if applicable; a description of the effluent controls used inside the mine if applicable; and an estimate of the efficiency of each control method or device.
6. Distances from the points of release to the nearest residence, school, business, or office and the nearest farms that produce vegetables, milk, and meat.
7. The values used for all other user-supplied input parameters for the computer model (such as meteorological data) and the source of these data.
8. All controls or other changes in operation of the facility that will be or are being installed to bring the facility into compliance.
9. If the facility is under a judicial or administrative enforcement decree, the report will describe the facility's performance under the terms of the decree.

Denison will maintain records that document the source of input parameters, including the results of all measurements used as their basis, the calculations or analytical methods (or both) used to derive values for input parameters, and the procedure used to evaluate compliance. The documentation will allow an independent auditor to verify the accuracy of the determination on the facility's compliance with the standard. These records will be kept at the mine site or by the owner or operator for at least 5 years. They will be made available upon request for inspection by EPA and ADEQ.

5.2 COMPLIANCE SCHEDULE

The source will meet in a timely manner applicable requirements that become effective during the permit term.

In relation to compliance with NESHAPs requirements, Table 5-1 below summarizes the monitoring and recordkeeping requirements and schedule.

TABLE 5-1

SUMMARY OF MONITORING AND RECORDKEEPING REQUIREMENTS

Requirement	Frequency	Due Date
Continuously Measure Rn-222 Emissions	Monthly (Monitoring frequency)	March 31 (Results reported annually)
Perform Annual Effective Dose Equivalent Calculations and Reporting	Yearly	March 31st
Perform Monthly Effective Dose Equivalent Calculations and Reporting (As Necessary)	Monthly	April 30 and every 30 days thereafter
Maintain Records on Source of COMPLY-R Input Parameters	Continuously	N/A (Must be kept for at least 5 years)

5.3 COMPLIANCE CERTIFICATION

A certification of compliance with all applicable requirements will be provided by a responsible Denison official. The certification will include:

1. Identification of the applicable requirements that are the basis of the certification;
2. A statement of methods used for evaluating compliance, including a description of monitoring, recordkeeping, and reporting requirements and test methods;
3. A schedule for submittal of compliance certifications during the permit term to be submitted no less frequently than annually, or more frequently if specified by the underlying applicable requirement or by the permitting authority;
4. A statement indicating the source's compliance status with any applicable enhanced monitoring and compliance certification requirements;
5. A certification of truth, accuracy, and completeness pursuant to R18-2-304(H). This certification and any other certification required under this article will attest that the statements and information in the document are true, accurate, and complete based on information and belief formed after reasonable inquiry.

6.0 CLASS II AREA AIR QUALITY IMPACT ANALYSIS

This section describes the technical approach for a Class II air quality impact analysis for the Arizona I Mine. For Class II analyses, the ADEQ Air Quality Division requires, on a case-by-case basis, that permit applicants use modeling for minor sources. Initial discussions were held with ADEQ Air Quality Division personnel (ADEQ 2007c) and it was determined that an air quality impact assessment would be required. A model protocol submitted for this project (Tetra Tech 2007) was accepted by ADEQ, with comments, in an email dated November 30, 2007 (ADEQ 2007d).

Estimations of annual criteria pollutant emissions predicted from the proposed facility are presented in Table 6-1. Criteria pollutants designated within the Clean Air Act include SO_2, NO_2, PM_{10}, CO, VOCs, and Pb. Table 6-2 shows the Class II Significant Impact Levels (SILs), which are used to assess whether a facility could have a significant impact at downwind receptors. In addition, Table 6-2 shows the National Ambient Air Quality Standards (NAAQS) that apply to the Arizona I Mine.

Modeling has been completed in accordance with guidance outlined in the *Air Dispersion Modeling Guidelines for Arizona Air Quality Permits* (ADEQ 2004) and EPA's *Guideline on Air Quality Models (Revised)* (EPA 2005).

The Arizona I Mine is considered to be a Class II or minor source because emissions from the Arizona I Mine are well below major source thresholds for the attainment area where the site is located. As a result, the mine will not be subject to Prevention of Significant Deterioration (PSD) requirements. ADEQ modeling requirements for non-PSD sources require applicants to model criteria pollutant impacts for comparison to the NAAQS. Discussions with the ADEQ permit manager, Trevor Baggiore (ADEQ 2007a), indicated that toxic pollutant modeling was not necessary.

In accordance with the ADEQ modeling guidelines (ADEQ 2004), representative background concentrations have been added to modeled impacts from the Arizona I Mine for the NAAQS analysis. Inclusion of regional sources is typically not required for Class II modeling analyses.

The following discusses the dispersion model that has been used in this analysis, potential wake effects of the buildings at the Arizona I Mine, meteorological data, receptors and topography, modeled emission sources, regional background concentrations, and a plume visibility impact analysis.

TABLE 6-1

TOTAL ANNUAL EMISSIONS FOR ARIZONA I MINE

Pollutant	Total Predicted Annual Emissions (tons/year)	Major Source Threshold (tons/year)
CO	0.2	250
NO_x	1.0	250
PM_{10}	11.7	250
VOC	0.38	250
SO_2	0.07	250
Pb	1.60E-11	5

Notes:

SO_2 – Sulfur dioxide
NO_X – Nitrogen oxides
PM_{10} – Particulate matter less than 10 microns in diameter
CO – Carbon monoxide
VOC – Volatile organic compounds
Pb – Lead

TABLE 6-2

CLASS II SIGNIFICANCE LEVELS AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Period	Significant Impact Levels ($\mu g/m^3$)[a]	National AAQS ($\mu g/m^3$)[a]
Nitrogen Dioxide	Annual	1	100
Sulfur Dioxide	Annual	1	80
	24-hour	5	365 [b]
	3-hour	25	1,300 [b]
Carbon Monoxide	8-hour	500	10,000[b]
	1-hour	2,000	40,000[b]
PM_{10}[c]	Annual	1	50
	24-hour	5	150[b,d]
Lead	Quarterly	NA	1.5
Ozone	1-hour	NA	235 [b]

Notes:

a $\mu g/m^3$ = Micrograms per cubic meter
b Not to be exceeded more than once per calendar year
c Particulate matter with aerodynamic diameter less than or equal to 10 microns
d At the request of ADEQ, high-first-high 24-hour PM_{10} concentrations will be reported.
NA Not applicable

6.1 DISPERSION MODEL SELECTION

At the request of ADEQ, gaseous pollutants (CO, NO_2, and SO_2) have been modeled using the SCREEN3 model. SCREEN3 is a single source Guassian plume model that predicts maximum ground-level concentrations, using worst-case meteorological conditions.

Dispersion modeling for PM_{10} has been conducted using the American Meteorological Society and EPA Regulatory Model Improvement Committee Dispersion Model (AERMOD version 07026). EPA recommends this model for evaluating Class II impacts within 50 kilometers (km) of the facility assessed. Additionally, AERMOD was developed to handle complex terrain. In this analysis, AERMOD was used to predict maximum pollutant concentrations in ambient air from Arizona I Mine emissions.

6.2 BUILDING WAKE EFFECTS

The AERMOD model inputs include building dimensions to assess the potential for downwash effects on emissions from associated nearby structures. Direction-specific downwash parameters were calculated using facility plot-plan maps, and BPIP-prime (BPIPPRM) software, which is the building downwash program associated with the AERMOD model. Output from BPIPPRM was incorporated into the AERMOD modeling input files.

6.3 LAND USE CLASSIFICATIONS

The proposed Arizona I Mine is located on the Kanab Plateau in Mohave County, Arizona, 6.6 miles north of Grand Canyon National Park Class I area. The Arizona I Mine is located 35 miles south of Fredonia, Arizona, at an elevation of 5,546 feet above mean sea level (amsl). The site is located in the east half of Section 22 and the west half of Section 23, Township 36 North, Range 5 West. The area of operations that will be temporarily used and disturbed during the project life covers 19.4 acres. The site and surrounding area are largely rural and have been classified as such in the modeling analysis.

6.4 METEOROLOGICAL DATA

The regional climate is characterized by long, hot summers and mild winters. The high desert terrain typically experiences low precipitation, low relative humidity, and a high percentage of sunny days.

Topography and elevation influence local climate by channeling winds through canyons. Increases in elevation generally result in greater precipitation and lower temperatures.

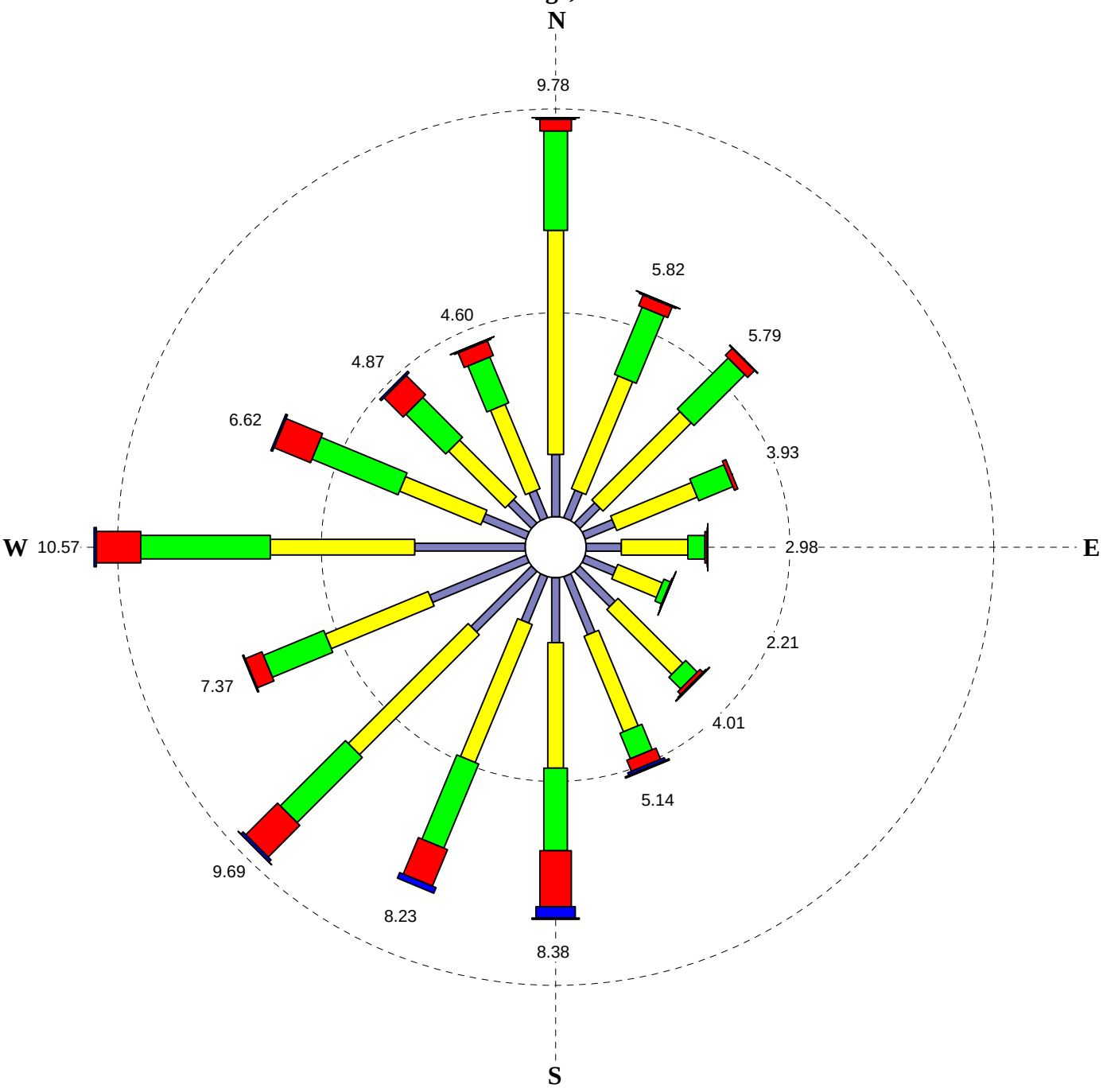
AERMOD dispersion modeling has been conducted using surface meteorological data from the National Weather Service (NWS) station located in Page, Arizona, for the period January 1, 2001, through December 31, 2005. Upper air meteorological data from the Flagstaff, Arizona, NWS station for the same period was also used. These data were selected because they are the most representative available for site conditions at the proposed Arizona I Mine. A wind rose plot of the surface meteorological data collected at Page is presented in Figure 6-1. This figure shows that the predominant winds in the area blow from the west through south, and from the north. Page and Flagstaff NWS data have been processed into model-ready format using EPA's AERMET software.

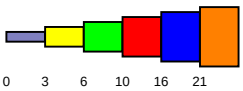
Surface characteristic data required as input to AERMET, but not included in the NWS dataset, were estimated using guidance in the User's Guide for the AERMOD Meteorological Preprocessor – AERMET (EPA 2004). These variables include albedo of the ground, Bowen ratio, and surface roughness. Based on the topography of the mine site, Denison has used values corresponding to desert shrubland in dry conditions for these variables.

6.5 PROCESS AREA BOUNDARY

ADEQ recognizes that ambient air begins at the PAB. Processes that directly constitute emission generating activity at a facility are operated and contained in the PAB. The process area for the Arizona I Mine includes only the immediate vicinity of the currently used portions of the property. A 6-foot chain link security fence with lockable gates encloses the activity area. The PAB has been set at the site fence line based on the layout of the proposed Arizona I Mine site and the limited operation area. The proposed PAB was shown in Section 2, Figure 2-1.

FIGURE 6-1
Denison Mines (USA) Corp.
Arizona I Mine
Windrose - Page, AZ 2001-2005





Wind Speed (Knots)

Calms excluded.
Rings drawn at 5% intervals.
Wind flow is FROM the directions shown.
8285 observations were missing.

6.6 RECEPTORS AND TOPOGRAPHY

The proposed Arizona I Mine modeling has been completed using a model receptor grid that ensures that maximum estimated impacts from the mine are identified. Following ADEQ and EPA guidelines, receptor locations were identified with sufficient density and spatial coverage to isolate the area with the highest impacts. Therefore, the following receptor location groups were used for the analysis:

- 25-meter (m) spacing – along PAB
- 100-m spacing – from PAB to 1 km
- 500-m spacing – from 1 km to 5 km from PAB
- 1,000-m spacing – from 5 km to 50 km from PAB

The Arizona I Mine is secured by a gate located at the entrance to the surface facilities area. Accordingly, the boundary of the surface facilities area is considered as the PAB. This area represents the bounded area for the mine. Receptors will also be placed along the site access road that is outside the surface facilities; these receptors will be located 50 feet from the centerline of the road to represent the edge of the road's right-of-way.

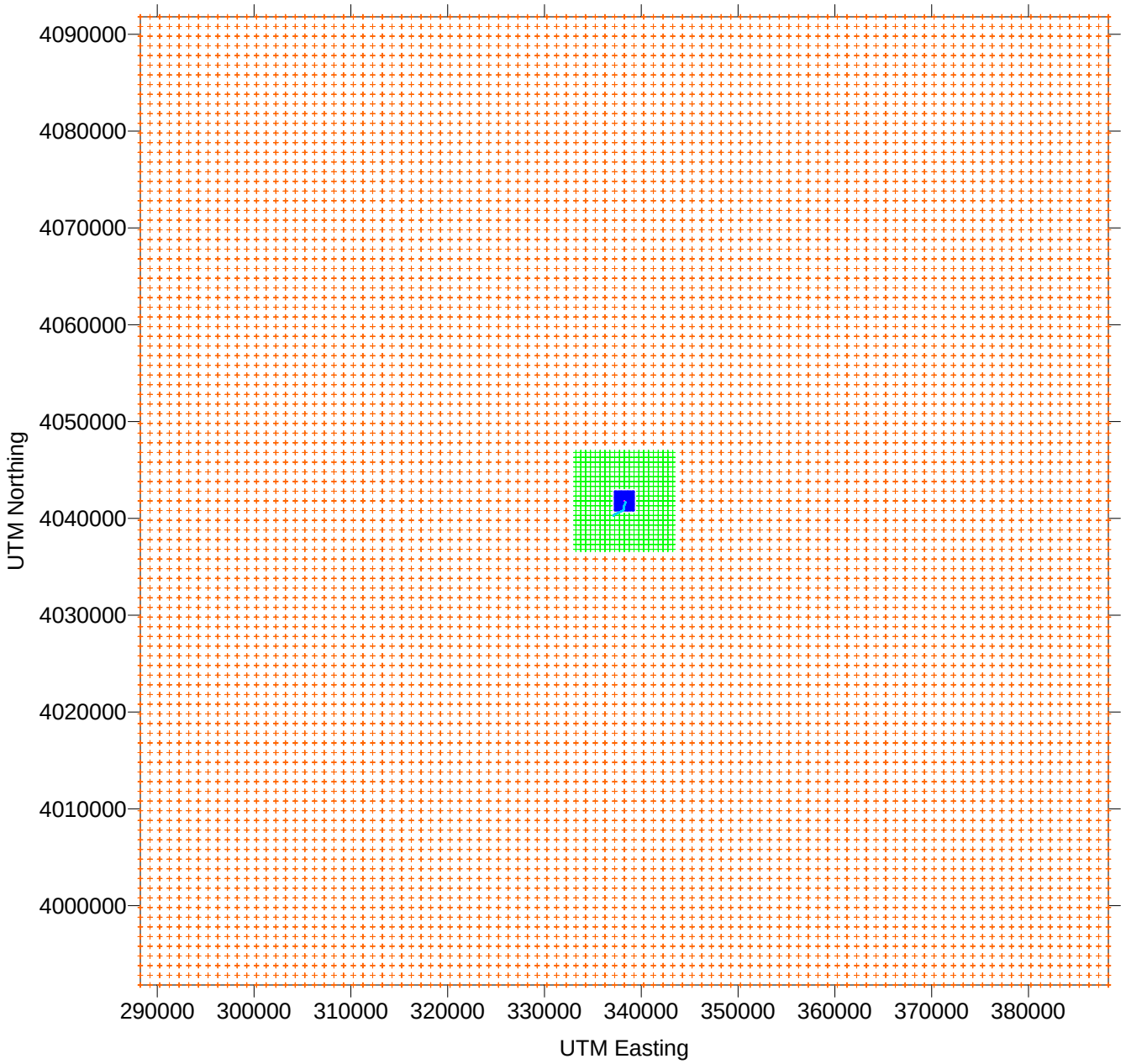
The total number of receptors is 11,151. Figure 6-2 shows the receptor grid relative to the proposed Arizona I Mine. Because of the large receptor domain, it is not practical to assign terrain elevations to all receptors using U.S. Geological Survey (USGS) 7.5-minute series digital elevation model (DEM) data. Therefore, receptors elevations have been assigned using USGS 1-degree DEM data for receptors beyond 10 km of the site. Model receptor elevations for receptors within 10 km of the site have been assigned using the higher-resolution 7.5-minute DEM data.

6.7 MODELED EMISSION SOURCES

Pollutant emissions from Arizona I Mine sources are projected to be very low. At the request of ADEQ, emissions for the emergency generator, as well as material handling and fugitive emissions, have been quantified and incorporated into a modeling analysis. The layout of the Arizona I Mine, in relation to the PAB is presented in Section 2, Figure 2-1.

Emissions for the Arizona I Mine standby generator combustion source were calculated using standard AP-42 emission calculation equations. Maximum 1-hour short-term emission rates were calculated for use in the SCREEN3 model. Material handling emissions were quantified for worst-case modeling

Figure 6-2
Denison Mines (USA) Corp
Arizona I Mine
Receptor Grid



conditions and included wind erosion emissions from storage piles. Emissions from gasoline and diesel storage tanks were estimated using the EPA TANKS software. Fugitive emissions from on-site roads have been modeled using the protocols developed by the Texas Commission on Environmental Quality (TCEQ), with ADEQ's minor exceptions referenced in the Air Dispersion Modeling Guidelines (2004). The following is a summary of the procedure recommended by TCEQ, with ADEQ modifications (in italics).

ADEQ Road Source Emission Volume Source Characterization

1. Determine the adjusted width of the road. The adjusted width is the actual width of the road plus 6 meters. The additional width represents turbulence caused by the vehicle as it moves along the road. *This width will represent a side of the base of the volume.*
2. Determine the number of volume sources, N. Divide the length of the road by the adjusted width. The result is the maximum number of volume sources that could be used to represent the road.
3. Determine the height of the volume. The height will be equal to twice the height of the vehicle generating the emissions, *rounded to the nearest meter*.
4. Determine the initial horizontal sigma for each volume.
    a. If the road is represented by a single volume, divide the adjusted width by 4.3.
    b. If the road is represented by adjacent volumes, divide the adjusted width by 2.15.
    c. If the road is represented by alternating volumes, divide by twice the adjusted width (measured from the center point of the first volume to the center point of the next represented volume) by 2.15. Start with the volume nearest to the property line. This representation is often used for long roads.
5. Determine the initial vertical sigma. Divide the height of the volume determined in Step 3 by 2.15.
6. Determine the release point. Divide the height of the volume by two. This point is the center of the volume.
7. Determine the emission rate for each volume used to calculate the initial horizontal sigma in Step 4. Divide the total emission rate equally among the individual volumes used to represent the road, unless there is a known spatial variation in emissions.
8. Determine the UTM coordinate for the release point. The release point location is in the center of the base of the volume. This location must be at least one meter from the nearest receptor.

The following assumptions were made in the calculations of sigma-y, release height, and sigma-z for volume sources other than roads:

Front-end loader loading/unloading:

Sigma-y: The front-end loader operates largely within a 25-meter radius. Therefore, sigma-y = 25/4.3 = 5.81m (per AERMOD volume source guidance).

Release height: The release height for this source is assumed to be 5.0 meters based on information available for this type of source.

Sigma-z is calculated based on release height, sigma-z = RH/2.13 = 5.0/2.13 = 2.35 (per AERMOD volume source guidance).

Storage piles:

Sigma-y is calculated based on estimated pile width or radius. These values were estimated based on the site plan provided by Denison and are located in Appendix B, Table B-1. Sigma-y = pile radius/4.3 (per AERMOD volume source guidance).

Release height is calculated based on estimated pile height. Pile heights were estimated based on information provided by Denison and are located in Appendix B, Table B-1. The emission point is assumed to be the center of the pile and is calculated as half of the pile height.

Sigma-z is calculated based on release height, sigma-z = RH/2.13 (per AERMOD volume source guidance).

Based on ADEQ requirements (ADEQ 2007c), criteria pollutants emitted from the proposed source have been modeled for this Class II analysis. The sources modeled for the significant impact analysis only include proposed Arizona I Mine sources. A summary of modeled emission sources is provided in Tables 6-3 and 6-4.

According to Arizona modeling guidelines (ADEQ 2004), representative pollutant background concentrations should be added to modeled impacts from the applicant facility for an NAAQS analysis of a minor source. Modeled impacts from the Arizona I Mine are added to appropriate background values, and then compared with NAAQS, because potential emissions from the Arizona I Mine qualify for minor source designation.

TABLE 6-3
DENISON MINES (USA) CORP. - ARIZONA 1 MINE
EMISSION SOURCE MODEL INPUT PARAMETERS

Source ID	Source UTM Location		Elevation	Annual Hours of Operation	Source Type	Stack/ Release Height (m)	Temperature (K)	Velocity (m/s)	Diameter (m)	Sigma-y (m)	Sigma-z (m)	Long-Term Emission Rates	Short-Term Emission Rates[2] (g/s)			
	Easting (m)	Northing (m)	(m)	(hr/yr)								PM_{10}	PM_{10}	SO_2	CO	NOX
Generators																
Gen400	338164.3	4041814.7	1658	120	Point	4.57	808.2	56.8	0.200	n/a	n/a	0.00204	0.0743	0.1386	0.451	2.095
Front-End Loader - Loading/Unloading																
FEL	338252.0	4041796.4	1660	8760	Volume	5.00	298.2	n/a	n/a	5.81	2.35	0.000992	0.000992	0.0	0.0	0.0
Storage Pile Emissions																
HGOS	338297.5	4041826.0	1660	8760	Volume	1.22	298.2	n/a	n/a	15.8	1.14	6.2E-04	6.2E-04	0.0	0.0	0.0
MGOS	338280.1	4041779.1	1660	8760	Volume	1.22	298.2	n/a	n/a	15.8	1.14	6.2E-04	6.2E-04	0.0	0.0	0.0
LGOS	338271.4	4041748.4	1660	8760	Volume	1.22	298.2	n/a	n/a	15.8	1.14	6.2E-04	6.2E-04	0.0	0.0	0.0
WDA	338355.2	4041884.8	1660	8760	Volume	0.76	298.2	n/a	n/a	53.4	0.72	2.4E-03	2.4E-03	0.0	0.0	0.0
TSPile	338349.6	4041803.6	1660	8760	Volume	1.22	298.2	n/a	n/a	57.2	1.14	2.3E-04	2.3E-04	0.0	0.0	0.0
Tank Emissions[1]																
AST1	338113.3	4041725.2	1660	8760	Point	5.50	298.2	0.01	0.01	n/a	n/a	0.0	0.0	0.0	0.0	0.0
AST2	338113.7	4041754.0	1660	8760	Point	8.75	298.2	0.01	0.01	n/a	n/a	0.0	0.0	0.0	0.0	0.0
Road Emissions																
See Model Input Files	From 338125.2 to 338316.1	From 4041692.9 to 4041882.0	From 1667.0 to 1669.3	8760	Volume	4.57	298.2	n/a	n/a	5.1	4.3	0.179	0.134	0.0	0.0	0.0

n/a - not applicable

1 Tank emissions are the only vertically restriced source. Horizontal discharge is assumed. All other sources are vertically unrestricted.

2 Short term emission rates are hourly emission rates for all emission estimates except PM10 for the generator. The short term PM10 emission rate for the generator is a 24-hour emission rate.

TABLE 6-4
DENISON MINES (USA) CORP. - ARIZONA 1 MINE
FUGITIVE ROAD EMISSION MODEL INPUT PARAMETERS

Road Segment ID	NAME	LENGTH (m)	UTM x (m)	UTM y (m)	Base Elevation (m)	Release Height (m)[1]	sigma (y0)	sigma (z0)	Long-Term PM_{10} Emission Rate (g/s)	Short-Term PM_{10} Emission Rate (g/s)
Access	Acc_1	36.38	338330.0	4041710.6	1669.54	4.57	16.92	4.25	0.00213	0.00148
	Acc_2	36.38	338359.2	4041691.1	1670.53	4.57	16.92	4.25	0.00213	0.00148
	Acc_3	36.38	338385.8	4041667.1	1671.18	4.57	16.92	4.25	0.00213	0.00148
	Acc_4	36.38	338377.1	4041632.2	1671.52	4.57	16.92	4.25	0.00213	0.00148
	Acc_5	36.38	338367.6	4041597.5	1671.91	4.57	16.92	4.25	0.00213	0.00148
	Acc_6	36.38	338357.1	4041563.1	1672.44	4.57	16.92	4.25	0.00213	0.00148
	Acc_7	36.38	338345.2	4041529.1	1673	4.57	16.92	4.25	0.00213	0.00148
	Acc_8	36.38	338331.3	4041495.9	1673.48	4.57	16.92	4.25	0.00213	0.00148
	Acc_9	36.38	338315.9	4041463.4	1674.06	4.57	16.92	4.25	0.00213	0.00148
	Acc_10	36.38	338300.1	4041431.0	1675	4.57	16.92	4.25	0.00213	0.00148
	Acc_11	36.38	338284.3	4041398.7	1675.88	4.57	16.92	4.25	0.00213	0.00148
	Acc_12	36.38	338268.4	4041366.4	1676.9	4.57	16.92	4.25	0.00213	0.00148
	Acc_13	36.38	338253.2	4041333.8	1678.13	4.57	16.92	4.25	0.00213	0.00148
	Acc_14	36.38	338238.3	4041301.1	1679.41	4.57	16.92	4.25	0.00213	0.00148
	Acc_15	36.38	338220.3	4041269.9	1680.54	4.57	16.92	4.25	0.00213	0.00148
	Acc_16	36.38	338202.5	4041238.6	1681.3	4.57	16.92	4.25	0.00213	0.00148
	Acc_17	36.38	338184.6	4041207.3	1682.19	4.57	16.92	4.25	0.00213	0.00148
	Acc_18	36.38	338165.9	4041176.6	1682.73	4.57	16.92	4.25	0.00213	0.00148
	Acc_19	36.38	338175.2	4041145.0	1683.29	4.57	16.92	4.25	0.00213	0.00148
	Acc_20	36.38	338192.6	4041113.5	1683.33	4.57	16.92	4.25	0.00213	0.00148
	Acc_21	36.38	338209.7	4041081.8	1682.51	4.57	16.92	4.25	0.00213	0.00148
	Acc_22	36.38	338219.0	4041047.5	1682.59	4.57	16.92	4.25	0.00213	0.00148
	Acc_23	36.38	338222.3	4041011.7	1683.48	4.57	16.92	4.25	0.00213	0.00148
	Acc_24	36.38	338222.9	4040975.8	1684.36	4.57	16.92	4.25	0.00213	0.00148
	Acc_25	36.38	338211.9	4040941.6	1684.62	4.57	16.92	4.25	0.00213	0.00148
	Acc_26	36.38	338192.7	4040911.2	1681.35	4.57	16.92	4.25	0.00213	0.00148
	Acc_27	36.38	338170.9	4040882.7	1677.54	4.57	16.92	4.25	0.00213	0.00148
	Acc_28	36.38	338145.9	4040856.8	1673.98	4.57	16.92	4.25	0.00213	0.00148
	Acc_29	36.38	338119.1	4040833.0	1667.89	4.57	16.92	4.25	0.00213	0.00148
	Acc_30	36.38	338091.0	4040810.4	1663.34	4.57	16.92	4.25	0.00213	0.00148
	Acc_31	36.38	338060.8	4040790.8	1661.26	4.57	16.92	4.25	0.00213	0.00148
	Acc_32	36.38	338030.4	4040771.7	1659.42	4.57	16.92	4.25	0.00213	0.00148
	Acc_33	36.38	337999.6	4040753.0	1657.98	4.57	16.92	4.25	0.00213	0.00148
	Acc_34	36.38	337967.1	4040737.6	1657.96	4.57	16.92	4.25	0.00213	0.00148
	Acc_35	36.38	337934.5	4040722.3	1657.25	4.57	16.92	4.25	0.00213	0.00148
	Acc_36	36.38	337901.9	4040707.0	1657.62	4.57	16.92	4.25	0.00213	0.00148
	Acc_37	36.38	337869.3	4040691.6	1656.06	4.57	16.92	4.25	0.00213	0.00148
	Acc_38	36.38	337836.8	4040676.3	1653.57	4.57	16.92	4.25	0.00213	0.00148
	Acc_39	36.38	337804.1	4040661.2	1651.27	4.57	16.92	4.25	0.00213	0.00148
	Acc_40	36.38	337771.2	4040646.5	1648.82	4.57	16.92	4.25	0.00213	0.00148
	Acc_41	36.38	337738.4	4040631.8	1646.51	4.57	16.92	4.25	0.00213	0.00148
	Acc_42	36.38	337705.5	4040617.2	1644.66	4.57	16.92	4.25	0.00213	0.00148
	Acc_43	36.38	337672.6	4040602.5	1643.96	4.57	16.92	4.25	0.00213	0.00148
	Acc_44	36.38	337639.7	4040587.8	1643.24	4.57	16.92	4.25	0.00213	0.00148
	Acc_45	36.38	337606.9	4040573.1	1640.81	4.57	16.92	4.25	0.00213	0.00148
	Acc_46	36.38	337574.0	4040558.4	1637.83	4.57	16.92	4.25	0.00213	0.00148
	Acc_47	36.38	337541.1	4040543.8	1635.61	4.57	16.92	4.25	0.00213	0.00148
	Acc_48	36.38	337508.3	4040529.1	1633.55	4.57	16.92	4.25	0.00213	0.00148
	Acc_49	36.38	337475.5	4040514.2	1631.55	4.57	16.92	4.25	0.00213	0.00148
	Acc_50	36.38	337443.5	4040497.6	1631.41	4.57	16.92	4.25	0.00213	0.00148
	Acc_51	36.38	337411.6	4040481.0	1633.73	4.57	16.92	4.25	0.00213	0.00148
	Acc_52	36.38	337379.7	4040464.4	1633.75	4.57	16.92	4.25	0.00213	0.00148
	Acc_53	36.38	337347.7	4040447.8	1636.56	4.57	16.92	4.25	0.00213	0.00148
	Acc_54	36.38	337316.1	4040430.6	1638.36	4.57	16.92	4.25	0.00213	0.00148
	Acc_55	36.38	337284.9	4040412.6	1640.82	4.57	16.92	4.25	0.00213	0.00148
	Acc_56	36.38	337253.8	4040394.6	1643.97	4.57	16.92	4.25	0.00213	0.00148
	Acc_57	36.38	337222.9	4040376.1	1646.2	4.57	16.92	4.25	0.00213	0.00148
	Acc_58	36.38	337193.1	4040355.9	1646.43	4.57	16.92	4.25	0.00213	0.00148
	Acc_59	36.38	337173.4	4040330.3	1646.36	4.57	16.92	4.25	0.00213	0.00148
	Acc_60	36.38	337140.5	4040307.1	1641.47	4.57	16.92	4.25	0.00213	0.00148
	Acc_61	36.38	337120.9	4040277.0	1635.77	4.57	16.92	4.25	0.00213	0.00148
	Acc_62	36.38	337103.2	4040245.6	1632.03	4.57	16.92	4.25	0.00213	0.00148

TABLE 6-4
DENISON MINES (USA) CORP. - ARIZONA 1 MINE
FUGITIVE ROAD EMISSION MODEL INPUT PARAMETERS

Road Segment ID	NAME	LENGTH (m)	UTM x (m)	UTM y (m)	Base Elevation (m)	Release Height (m)[1]	sigma (y0)	sigma (z0)	Long-Term PM_{10} Emission Rate (g/s)	Short-Term PM_{10} Emission Rate (g/s)
A	A_1	10.88	338316.1	4041714.8	1668.69	4.57	5.06	4.25	0.00060	0.00040
	A_2	10.88	338305.3	4041717.0	1668.26	4.57	5.06	4.25	0.00060	0.00040
	A_3	10.88	338294.5	4041719.2	1668.04	4.57	5.06	4.25	0.00060	0.00040
	A_4	10.88	338283.7	4041719.2	1667.92	4.57	5.06	4.25	0.00060	0.00040
	A_5	10.88	338272.9	4041723.5	1667.87	4.57	5.06	4.25	0.00060	0.00040
	A_6	10.88	338262.2	4041723.5	1667.96	4.57	5.06	4.25	0.00060	0.00040
	A_7	10.88	338251.4	4041727.9	1667.9	4.57	5.06	4.25	0.00060	0.00040
	A_8	10.88	338240.6	4041730.0	1668.02	4.57	5.06	4.25	0.00060	0.00040
	A_9	10.88	338229.8	4041732.2	1668.09	4.57	5.06	4.25	0.00060	0.00040
	A_10	10.88	338219.0	4041734.4	1668.19	4.57	5.06	4.25	0.00060	0.00040
	A_11	10.88	338208.2	4041734.4	1668.34	4.57	5.06	4.25	0.00060	0.00040
	A_12	10.88	338197.5	4041738.7	1668.41	4.57	5.06	4.25	0.00060	0.00040
B	B_1	10.88	338200.5	4041748.4	1668.15	4.57	5.06	4.25	0.00205	0.00184
	B_2	10.88	338203.9	4041758.8	1668.01	4.57	5.06	4.25	0.00205	0.00184
	B_3	10.88	338207.3	4041769.3	1667.91	4.57	5.06	4.25	0.00205	0.00184
	B_4	10.88	338210.7	4041779.8	1667.73	4.57	5.06	4.25	0.00205	0.00184
	B_5	10.88	338214.0	4041790.2	1667.54	4.57	5.06	4.25	0.00205	0.00184
	B_6	10.88	338217.4	4041800.7	1667.4	4.57	5.06	4.25	0.00205	0.00184
	B_7	10.88	338220.8	4041811.2	1667.35	4.57	5.06	4.25	0.00205	0.00184
	B_8	10.88	338224.1	4041821.7	1667.32	4.57	5.06	4.25	0.00205	0.00184
	B_9	10.88	338227.5	4041832.1	1667.35	4.57	5.06	4.25	0.00205	0.00184
	B_10	10.88	338230.9	4041842.6	1667.21	4.57	5.06	4.25	0.00205	0.00184
	B_11	10.88	338234.2	4041853.1	1667.08	4.57	5.06	4.25	0.00205	0.00184
	B_12	10.88	338237.6	4041863.5	1666.99	4.57	5.06	4.25	0.00205	0.00184
C	C_1	12.80	338226.9	4041866.2	1667.28	4.57	5.06	4.25	0.00004	0.00004
	C_2	12.80	338216.3	4041868.8	1667.5	4.57	5.06	4.25	0.00004	0.00004
	C_3	12.80	338205.6	4041871.5	1667.51	4.57	5.06	4.25	0.00004	0.00004
	C_4	12.80	338194.9	4041874.1	1667.69	4.57	5.06	4.25	0.00004	0.00004
	C_5	12.80	338184.2	4041876.8	1667.92	4.57	5.06	4.25	0.00004	0.00004
	C_6	12.80	338173.5	4041879.4	1668.03	4.57	5.06	4.25	0.00004	0.00004
D	D_1	10.88	338163.0	4041882.0	1668.21	4.57	5.06	4.25	0.00003	0.00003
	D_2	10.88	338160.3	4041871.3	1668.28	4.57	5.06	4.25	0.00003	0.00003
	D_3	10.88	338157.6	4041860.7	1668.25	4.57	5.06	4.25	0.00003	0.00003
	D_4	10.88	338154.9	4041850.0	1668.02	4.57	5.06	4.25	0.00003	0.00003
	D_5	10.88	338152.2	4041839.4	1668.12	4.57	5.06	4.25	0.00003	0.00003
	D_6	10.88	338149.5	4041828.7	1668.2	4.57	5.06	4.25	0.00003	0.00003
	D_7	10.88	338146.8	4041818.0	1668.28	4.57	5.06	4.25	0.00003	0.00003
	D_8	10.88	338144.1	4041807.4	1668.37	4.57	5.06	4.25	0.00003	0.00003
	D_9	10.88	338141.4	4041796.7	1668.47	4.57	5.06	4.25	0.00003	0.00003
	D_10	10.88	338138.7	4041786.0	1668.54	4.57	5.06	4.25	0.00003	0.00003
	D_11	10.88	338136.0	4041775.4	1668.72	4.57	5.06	4.25	0.00003	0.00003
	D_12	10.88	338133.3	4041764.7	1668.9	4.57	5.06	4.25	0.00003	0.00003
	D_13	10.88	338130.6	4041754.1	1668.96	4.57	5.06	4.25	0.00003	0.00003
	D_14	10.88	338127.9	4041743.4	1669.06	4.57	5.06	4.25	0.00003	0.00003
	D_15	10.88	338125.2	4041732.7	1669.28	4.57	5.06	4.25	0.00003	0.00003
E	E_1	12.06	338130.2	4041725.7	1669.22	4.57	5.06	4.25	0.00085	0.00085
	E_2	12.06	338140.2	4041721.1	1669.07	4.57	5.06	4.25	0.00085	0.00085
	E_3	12.06	338150.2	4041716.4	1669.03	4.57	5.06	4.25	0.00085	0.00085
	E_4	12.06	338160.1	4041711.8	1669	4.57	5.06	4.25	0.00085	0.00085
	E_5	12.06	338170.1	4041707.1	1669	4.57	5.06	4.25	0.00085	0.00085
	E_6	12.06	338180.1	4041702.5	1668.95	4.57	5.06	4.25	0.00085	0.00085
	E_7	12.06	338190.0	4041697.8	1668.91	4.57	5.06	4.25	0.00085	0.00085
F	F_1	10.01	338200.5	4041692.9	1668.92	4.57	5.06	4.25	0.00127	0.00127
	F_2	10.01	338210.3	4041698.1	1668.68	4.57	5.06	4.25	0.00127	0.00127
	F_3	10.01	338220.0	4041703.3	1668.54	4.57	5.06	4.25	0.00127	0.00127
	F_4	10.01	338229.7	4041708.5	1668.43	4.57	5.06	4.25	0.00127	0.00127
	F_5	10.01	338239.4	4041713.7	1668.3	4.57	5.06	4.25	0.00127	0.00127
	F_6	10.01	338249.1	4041718.9	1668.05	4.57	5.06	4.25	0.00127	0.00127
	F_7	10.01	338258.8	4041724.1	1667.94	4.57	5.06	4.25	0.00127	0.00127

1 The release height is assumed to be 15 feet.

6.8 REGIONAL BACKGROUND CONCENTRATIONS

Ambient background concentrations represent the contribution of pollutant sources that are not included in the modeling analysis, including naturally occurring sources. The ambient background concentrations proposed for this modeling have been provided by ADEQ (ADEQ 2007c) and are shown in Table 6-5.

TABLE 6-5

BACKGROUND CONCENTRATIONS

Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$)[a]
NO_2[b]	Annual	4 (0.002 ppm)
SO_2[c]	Annual	3
	24-hour	16
	3-hour	73
CO[d]	8-hour	582
	1-hour	582
PM_{10}[e]	Annual	18
	24-hour	47

Notes:

a $\mu g/m^3$ = Micrograms per cubic meter

b Long-term average value (0.002 parts per million [ppm]) of several monitors located near power plants in rural areas of Arizona.

c Maximum value at SRP Springerville Generating Station (2002, 2004-2005).

d Typical continental ambient CO background value (0.5 ppm) used in most regional models.

e Three-year average (2003-2005) of the maximum values at the Flagstaff Middle School.

6.9 VISIBILITY IMPACT ANALYSIS

ADEQ requested that Denison conduct a visibility analysis to assess how the Arizona I Mine emissions would affect visibility in Class I areas. The site is located 6.6 miles north of Grand Canyon National Park (a Class I area).

How the analysis is conducted depends on a number of factors, including the number of sources and the distance from the sensitive areas. The Arizona I Mine is located less than 50 km from the Grand Canyon National Park and is therefore classified as a nearby source from the Class I area. The visibility analysis recommended for nearby sources is a screening visibility analysis to evaluate the impact of distinct plumes.

The perceptibility of a distinct plume depends on the plume contrast at all visible wavelengths. Perceptibility is a function of changes in both brightness and color. The color difference parameter, ΔE, was developed to specify the perceived magnitude of changes in color and brightness and is used as the primary basis for assessing perceptibility of plume visual impacts in the screening analysis.

Plume contrast results from an increase or decrease in light transmitted from the viewing background through the plume to the observer. This increase or decrease in light intensity is caused by plume constituents that scatter and/or absorb light.

Dispersion modeling has been completed with a Level I Screening assessment using the VISCREEN model to evaluate the potential for visibility impairment at nearby sensitive areas. Visibility modeling was completed to estimate ΔE and contrast due to proposed maximum 24-hour emissions from the emergency generator stack at nearby Class I areas.

Level-1 Screening is designed to provide a conservative estimate of visual impacts from the plume. This conservatism is achieved by the use within the screening model VISCREEN of worst-case meteorological conditions: extremely stable (F) atmospheric conditions, coupled with a very low wind speed (1 meter per second [m/s]) persisting for 12 hours, with a wind that would transport the plume directly adjacent to the observer. The observer is located at the closest location of the Class I area to the proposed source per VISCREEN guidance (EPA 1992), in this case, the north rim of the Grand Canyon National Park.

Proposed maximum short-term emergency generator stack emissions of primary PM, NO_x, primary NO_2, soot (elemental carbon [EC]), and primary sulfate (SO_4) were input to the model for the visibility analysis. Regional background visual range was established using the values recommended in the EPA guidance document *Workbook for Plume Visual Impact Screening and Analysis (Revised)* (EPA 1992), as well as *Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule* (EPA 2003).

6.10 REGIONAL HAZE ANALYSIS

Tetra Tech has conducted an analysis in consultation with ADEQ to determine the need for a regional haze assessment in Class I and other sensitive areas surrounding the proposed site, using the CALPUFF model in screening mode. Based on the analysis described below, it has been determined that this assessment is not required.

Regional haze is visibility impairment caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area (EPA 2003). This type of visibility impairment is evaluated for areas 50 km or more from an emission source. Based on the estimated emissions from the proposed source, it was not anticipated that the source would create a significant contribution to regional haze in the area. Results of AERMOD analyses that predict pollutant concentrations in nearby Class I areas are used to justify this assumption.

The federal land managers have recommended an initial screen to eliminate small or distant sources from the requirement to complete a haze visibility analysis. The method proposed by the National Park Service (NPS 2007) to screen insignificant sources uses the Q/D method. The term Q represents a source's total proposed emissions of SO_2, SO_4, NO_X, and PM in tpy. The term D represents the distance from the source to the Class I area in kilometers. If the term Q/D is less than or equal to 10, then the source is assumed to be insignificant relative to haze impacts at the Class I area. The equation is represented by,

$$Q/D \leq 10$$

The D term for the Arizona I Mine is 50 km because haze impacts are evaluated at 50 km and further from a source. As stated, potential plume visual impacts will be evaluated for distances less than 50 km. Adding up the total emissions from the Arizona I Mine, the Q term is 12.8 tpy. Therefore, the screening equation becomes,

$$12.8/50 = 0.26$$

The Arizona I Mine is far below the initial screen for haze impacts. Based on this information, a haze visibility analysis is not warranted for the Arizona I Mine.

6.11 SUMMARY OF MODELING RESULTS

6.11.1 SCREEN Modeling Results

Maximum SO_2, NO_2 and CO concentrations were analyzed using the SCREEN3 model. Maximum predicted 1-hour concentrations were multiplied by conversion factors for simple terrain screen modeling presented in Table 1 of the Air Dispersion Modeling Guidelines for Arizona Air Quality Permits (ADEQ 2004). Table 6-6 presents the factors used for this analysis.

TABLE 6-6

DENISON MINES (USA) CORP. – ARIZONA I MINE
CONVERSION FACTORS USED IN ANALYSIS

Model Output	3-Hour Average	8-Hour Average	24-Hour Average	Annual Average
Simple 1-hour	0.9	0.7	0.4	0.08

Table 6-7 presents results of the SCREEN3 modeling analysis, in addition to applicable background concentrations for comparison to the NAAQS. This very conservative modeling analysis demonstrates that the Arizona I Mines project will comply with the NAAQS levels for SO_2, NO_2, and CO.

TABLE 6-7

DENISON MINES (USA) CORP. – ARIZONA I MINE
SCREEN3 NAAQS DISPERSION MODELING RESULTS

Pollutant	Averaging Period	Highest Modeled Concentration ($\mu g/m^3$)[a]	Background Concentration ($\mu g/m^3$)[a]	Total Concentration ($\mu g/m^3$)[a]	NAAQS[b] ($\mu g/m^3$)[a]
SO_2	3-Hour	17.3	73	90.3	1300
	24-Hour	7.7	16	23.7	365
	Annual	1.5	3	4.5	80
NO_2	Annual	23.2	4	27.2	100
CO	1-Hour	62.6	582	644.6	40,000
	8-Hour	43.8	582	625.8	10,000

[a] Micrograms per cubic meter
[b] Short-term NAAQS allows limits to be exceeded once per calendar year.

A table presenting SCREEN3 model results for receptors modeled from 50 to 50,000 m is presented in Appendix E.

6.11.2 AERMOD Modeling Results

AERMOD dispersion modeling for PM_{10} demonstrates that the Arizona I Mine project will comply with the NAAQS. Table 6-8 presents results of the AERMOD modeling analysis, in addition to applicable background concentrations for comparison to the NAAQS.

TABLE 6-8

DENISON MINES (USA) CORP. – ARIZONA I MINE
AERMOD NAAQS DISPERSION MODELING RESULTS

Pollutant	Averaging Period	Year	Highest Modeled Concentration[a] ($\mu g/m^3$)[b]	Background Concentration ($\mu g/m^3$)[b]	Total Concentration ($\mu g/m^3$)[b]	NAAQS[c] ($\mu g/m^3$)[b]
PM_{10}	24-Hour	2003	20.1	47	67.1	150
	Annual	2001	4.45	18	22.5	50

[a] High-first-high modeled concentrations are presented for both short-term and annual averaging periods, per ADEQ request (ADEQ 2007a).
[b] Micrograms per cubic meter
[c] Short-term NAAQS allows limits to be exceeded once per calendar year.

The highest 24-hour and annual PM_{10} impacts, with background values added, are 67.1 $\mu g/m^3$ and 22.5 $\mu g/m^3$, respectively. These values are well below the respective NAAQS values of 150 $\mu g/m^3$ and 50 $\mu g/m^3$. Figures 6-3 and 6-4 present NAAQS impact contours for PM_{10}. The majority of the PM_{10} impacts originate from the unpaved roads and the emergency generator and reflect the proximity of the fence line to both of these sources. These results reflect worst case conditions.

The emergency generator will operate only during line power failure and for testing. It is highly unlikely that the generator will run over a consecutive 12-hour period, as predicted in the model. It is also highly unlikely that the generator will be operational during worst-case modeled meteorological conditions.

Calculations to estimate fugitive emissions generated by vehicle traffic over roads involve a number of parameters, most of which cannot be accurately estimated unless they are measured at a specific site (TCEQ 1999). The TCEQ indicates in its 1999 air quality modeling guidance that unrepresentative predictions of concentrations from road emissions are likely as a result of the modeling process because the modeling process is based on the assumption that emissions are continuous. The amount of road emissions is directly related to the type and amount of road traffic, which will not be continuous or uniform at the proposed Arizona I Mine site. TCEQ guidance states that, "Combined with worst-case

Figure 6-3
Denison Mines (USA) Corp
Arizona I Mine
2003 PM10 24-Hour NAAQS Results

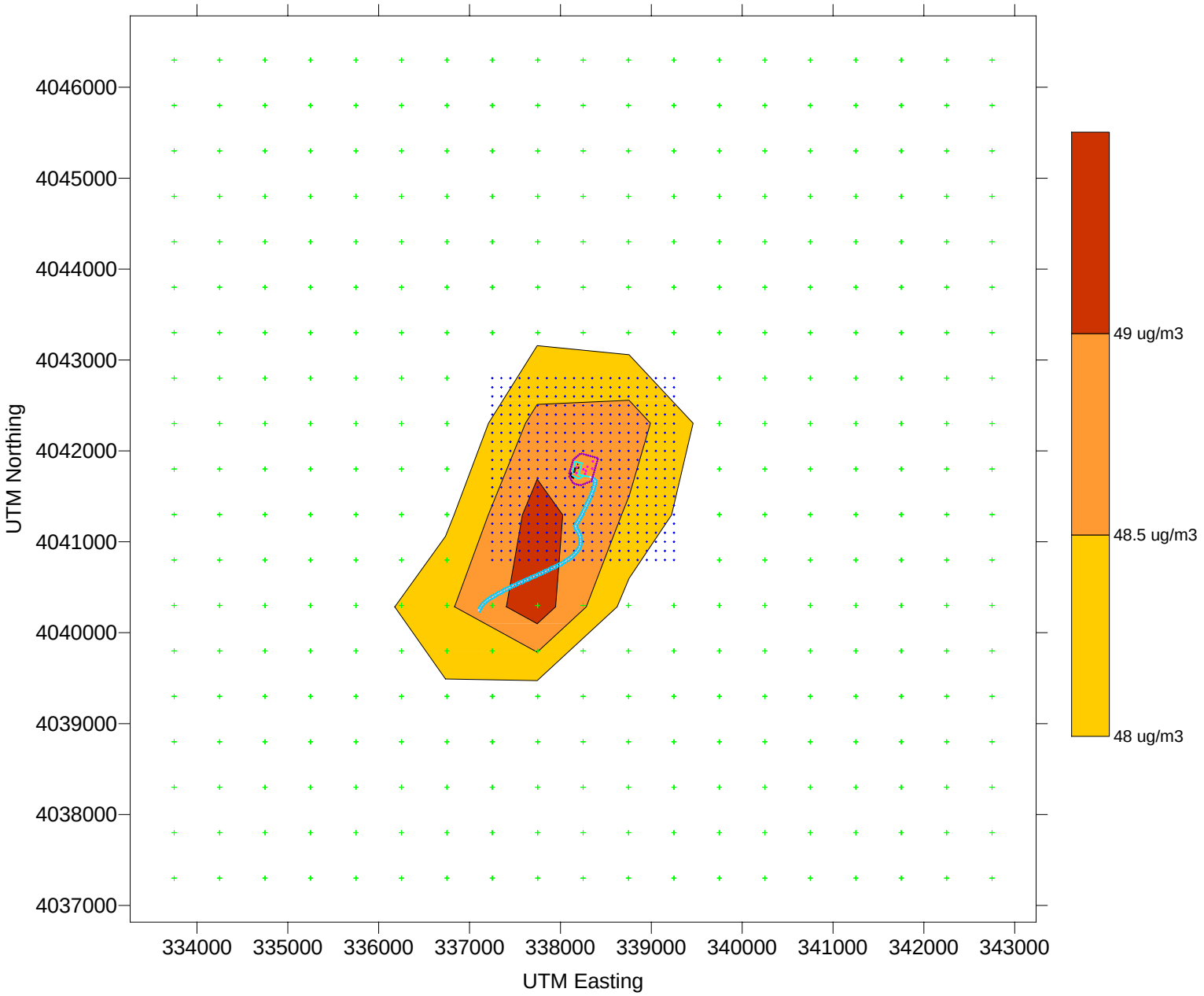
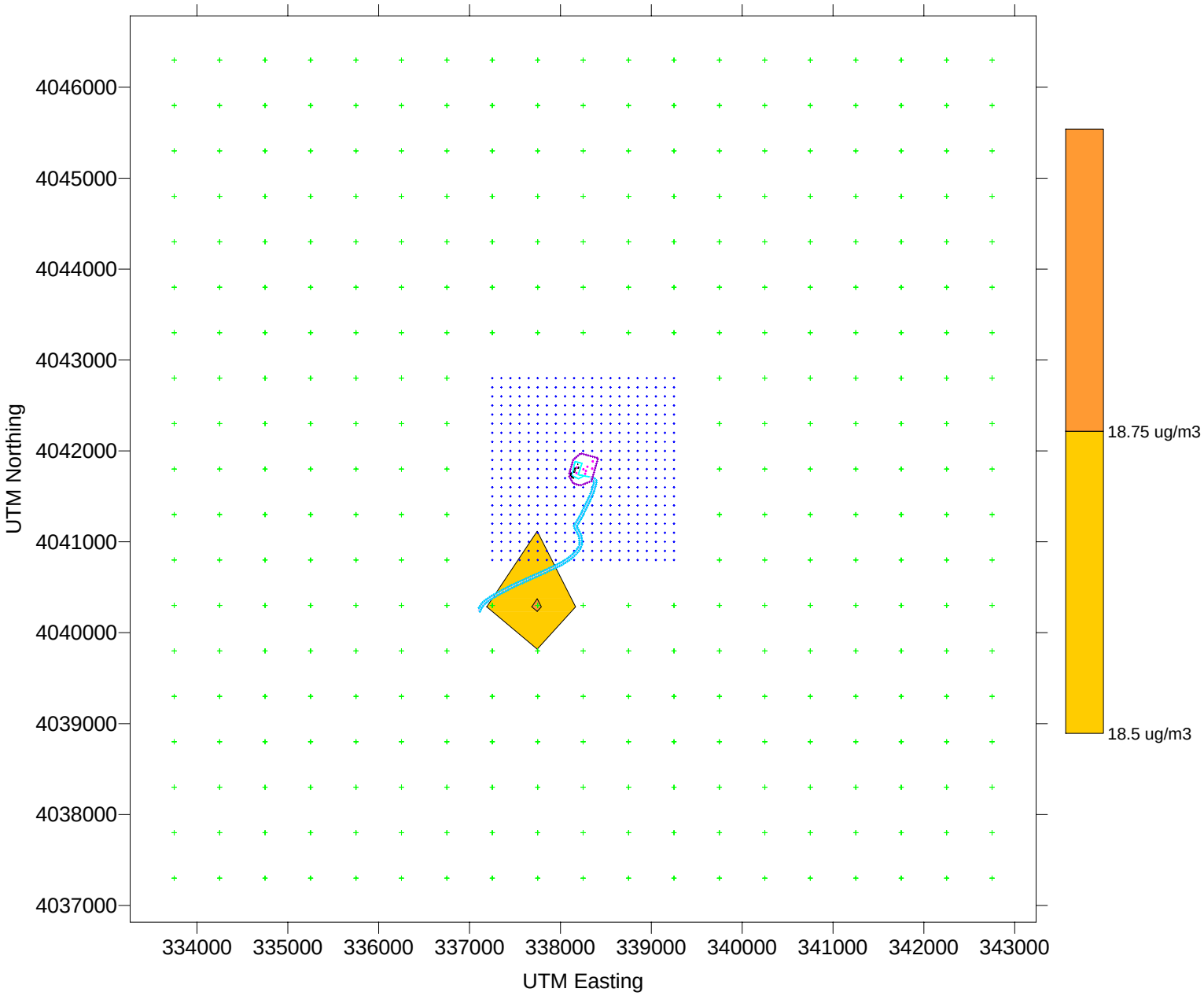


Figure 6-4
Denison Mines (USA) Corp
Arizona I Mine
2001 PM10 Annual NAAQS Results



operating scenarios, the modeling tool will overpredict concentrations, particularly in the vicinity of the source, and may incorrectly identify road emissions as the major cause of air pollution at a site. Often, control measures and best management practices are the most effective means to address off-property impacts from road sources."

6.11.3 VISCREEN Modeling Results

The plume visual impact screening model VISCREEN is designed to ascertain whether the plume from a facility has the potential to be perceptible to untrained observers under "reasonable worst case" conditions. The first criterion is a ΔE value of 2.0; the second is a contrast value of 0.05 (EPA 1992).

Table 6-9 presents results of the VISCREEN modeling analysis. The VISCREEN modeling demonstrates that the Arizona I Mine project will comply with the criteria established in the *Workbook for Plume Visual Impact Screening and Analysis (Revised)* (EPA 1992) for maximum visual impacts inside the Grand Canyon National Park.

TABLE 6-9

DENISON MINES (USA) CORP. – ARIZONA I MINE
CLASS I VISIBILITY MODELING RESULTS
MAXIMUM VISUAL IMPACTS INSIDE THE CLASS I AREA

Background	Theta	Azimuth	Distance	Alpha	Delta E		Absolute Contrast	
					Screening Criteria	Plume	Screening Criteria	Plume
Sky	10	163	31.2	6	2.00	1.845	0.05	0.000
Sky	140	163	31.2	6	2.00	1.097	0.05	-0.014
Terrain	10	163	31.2	6	2.00	1.689	0.05	0.015
Terrain	140	163	31.2	6	2.00	0.919	0.05	0.007

A print-out of VISCREEN modeling results is presented in Appendix F.

All modeling electronic files are included on CD-ROM in Appendix G.

7.0 REFERENCES

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